Updated Version 26 Feb 02

SSG JOHN W. KRECKLE
NONCOMISSIONED OFFICER ACADEMY
Map Reading Reinforcement Training Packet
Primary Leadership Development Course (PLDC)

"NO ONE IS MORE PROFESSIONAL THAN "

DEPARTMENT OF THE ARMY
NONCOMMISSIONED OFFICER ACADEMY
2267 KENTUCKY AVE.
FORT CAMPBELL, KY 42223

REPLY TO
ATTENTION OF:

AFZB-NCOA 27 February 2002

MEMORANDUM FOR ALL CONCERNED PERSONNEL

SUBJUCT: Map Reading Training

1. Purpose: Identify specific areas of training for Map Reading and Land Navigation.

2. General: The NCOA will no longer formally teach skill level one Map Reading tasks. Students will receive reinforcement training for the purpose of refreshing themselves in these skills. Recommend that all CSMs have their soldiers--at a minimum--read and study the following prior to arriving at PLDC.

a. STP 21-1-SMCT, Oct 94, Soldier's Manual of Common Tasks, dtd Oct 94, pages 23 through 66, the following tasks:

(1) 071-329-1000, Identify topographic symbols on a military map.
(2) 071-329-1001, Identify terrain features on a map.
(3) 071-329-1002, Determine the grid coordinates of a point on a military map.
(4) 071-329-1003, Determine a magnetic azimuth using a lensatic compass.
(5) 071-329-1005, Determine a location on the ground by terrain association.
(6) 071-329-1008, Measure distance on a map.
(7) 071-329-1012, Orient a map to the ground by map terrain association.
(8) 071-329-1018, Determine direction without a compass.

b. FM 3-25.26, Map Reading and Land Navigation:

(1) Chapter 3, para 3-1, 3-3, and 3-5.
(2) Chapter 4, para 4-4 thru 4-7.
(3) Chapter 5, para 5-1 and 5-2.
(4) Chapter 9, para 9-2 thru 9-3c, and 9-5
(5) Chapter 10, para 10-6
(6) Chapter 11, para 11-1b thru 11-3.

CSMs should design their own exercises with a map of the local area to ensure soldiers are proficient on these tasks. In addition we are making this RTP available to the CSMs to design their own refresher package. This training should be conducted prior to utilizing the Division Land Navigation Site. This is not a requirement; however by conducting this training before a soldier gets to the Site it will greatly increase the effectiveness of the training.

/original signed/
ALBERT J. BARTEE
MSG, USA
Chief of Training

Map Reading/Land Navigation Student RTP

Purpose

This RTP provides students with a standardized plan for reinforcement training of the skill level one tasks listed below:

This RTP Contains

Table of Contents

RECOVERABLE PUBLICATIONS

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Identify Topographic Symbols on a Military Map

Task This section of the RTP teaches--

Task Number:	071-329-1000
Task Title:	Identify topographic symbols on a military map.
Conditions:	Given a standard 1:50,000-scale military map.
Standards:	Identify the topographic symbols, colors, and marginal information on a military map with 100 percent accuracy.

(References: FM 3-25.26, Chapter 3; STP 21-1-SMCT, Oct 94, page 23)

Colors on a Military Map

The ideal situation would be that every mapmaker could show every map feature in its true shape and size; however, it's impossible. The amount of detail the map shows will increase or decrease dependent on the scale of the map.

Topographic symbols show details on the map and these symbols use six basic colors, Figure 1.

COLORS	SYMBOLS
Black	Cultural (man-made) features other than roads
Blue	Water
Brown	All relief features--contour lines on old maps--cultivated land on red-light readable maps.
Green	Vegetation
Red	Major roads, built-up areas, special features on old maps.
Red-brown	All relief features and main roads on red-light readable maps.

Figure 1

Symbols on a Military Map

Mapmakers use symbols on a map to represent physical features, such as physical surroundings or objects, as shown in Figure 2.

The shape of an object on the map will usually tell what it is, e.g., a black solid square is a building or a house, and a round or irregular blue item--a lake or pond.

Logic and what the colors mean must work together to determine a map feature, e.g., blue represents water. If you see a symbol that is blue and has clumps of grass, this would be a swamp.

Symbols on a Military Map, continued

The size of the symbol shows the approximate size of that object. Most symbols are six to ten times larger so that you can see them under dim light.

You should use the legend--located in the lower left margin of a map--to find an explanation of the symbols and features used on the map.

FEATURES	COLORS	DESCRIPTION
Drainage	Blue	These symbols include lakes, streams, rivers, marshes, swamps, and coastal waters.
Relief	Brown	These features are normally shown by contour lines, intermediate contour lines, and form lines. In addition to contour lines, there are relief symbols to show cuts, levees, sand, sand dunes, ice fields, strip mines, and glaciers.
Vegetation	Green	These symbols include woods, scrub, orchards, vineyards, tropical grass, mangrove and marshy areas, or tundra.
Roads	Red, Black, or Red-brown	These symbols show hard-surface, heavy-duty roads; hard surface, medium-duty roads; improved light-duty roads; unimproved dirt roads; and trails. On foreign road maps, symbols may differ slightly; check the map legend for proper identification of roads.
Railroads	Black	These symbols show single-track railroads in operation; single-track railroads not in operation; double or multiple-track railroads.
Buildings	Black, yellow, Red, or Pink	These symbols show built-up areas, schools, churches, ruins, lighthouses, windmills, and cemeteries.

Figure 2

Marginal Information

Marginal information explains useful information about a map. All maps do not have the same marginal information. Examine all marginal information each time you use a different map.

NOTE: Each of the items listed below has a reference, e.g., (Ref: FM 3-25.26, Chapter 3, page 3-1, para 3-1a**(1)**), or (Ref: FM 3-25.26, Chapter 3, page 3-1, para 3-1f**(6)**), The numbers in bold parenthesis **(1)** will match the number in Figure 3 on page 4 of this RTP to provide you the location of the item. You can then look at the item on your Tenino map in order to see the item clearer.

Marginal Information, continued

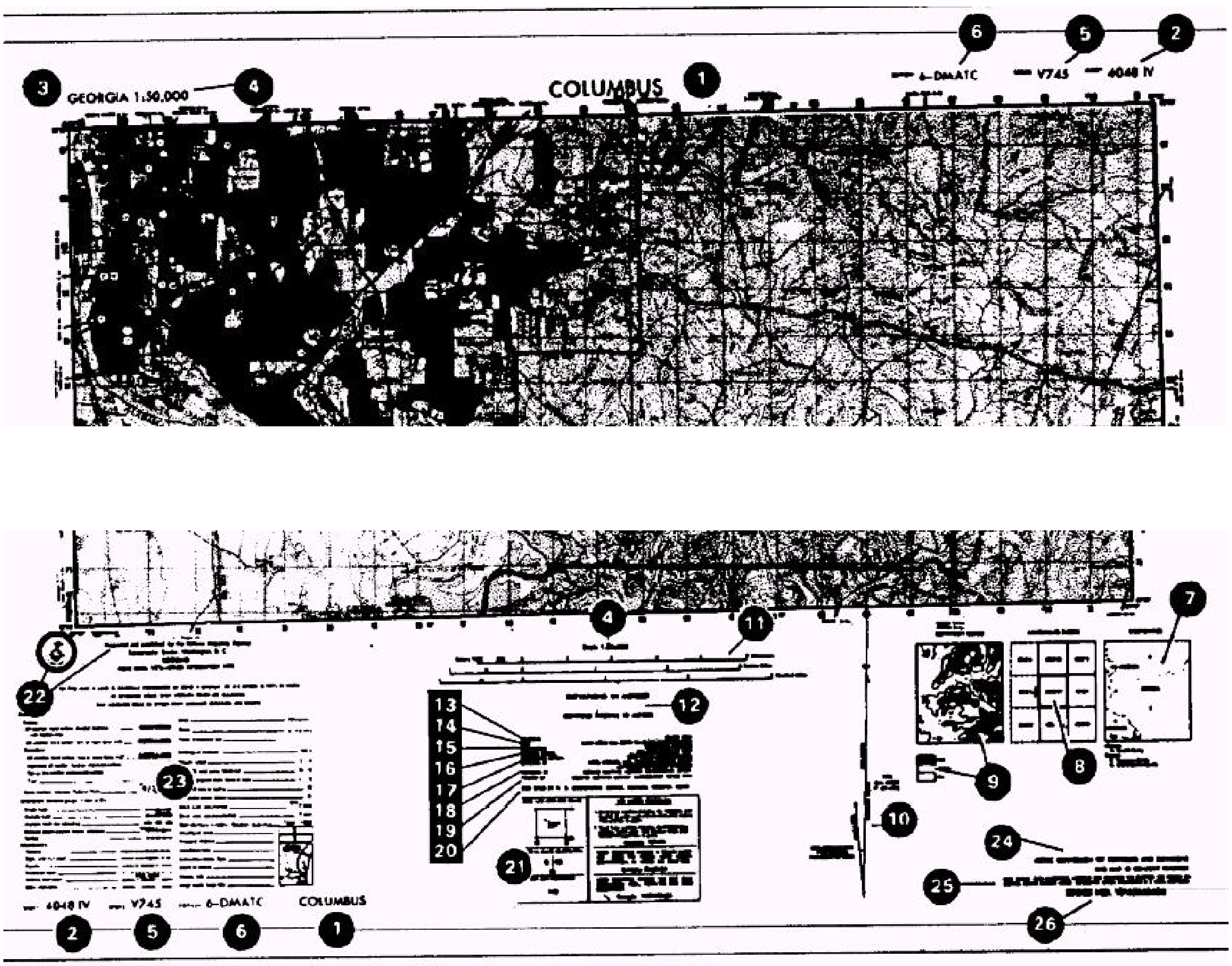


Figure 3

Sheet Name (1) (Ref: FM 3-25.26, Chapter 3, page 3-1, para 3-1a**(1)**)

The sheet name, located at the center of the top and in the lower left area of the map margin, is in bold print. The map name on your Tenino map is just that "Tenino." Mapmakers generally name the map after the largest settlement or natural feature located entirely within the area of the map sheet.

Sheet Number (2)

(Ref: FM 3-25.26, Chapter 3, page 3-1, para 3-1b**(2)**)

The location of the sheet number--in bold print--is in both the upper right and lower left areas of the margin, and in the center box of the adjoining sheets diagram, found in the lower right margin. You use it as a reference number to link specific maps to overlays, operations orders, and plans. On the Tenino Map, the sheet number is **1477IV.**

Series Name (3)

(Ref: FM 3-25.26, Chapter 3, page 3-1, para 3-1c**(3)**)

You will find the map series name in bold print in the upper left corner of the margin. The name given to the series is generally that of a major political subdivision, such as a state within the United States, or a European nation. On your Tenino map, the Series Name is **Washington.**

Scale (4)

(Ref: FM 3-25.26, Chapter 3, page 3-1, para 3-1d**(4)**)

The scale of the map appears in both the upper left margin after the series name and in the lower center of the bottom margin. The scale is a representative fraction that gives the ratio of a map distance to the corresponding distance on the earth's surface. For example, the scale 1:50,000 indicates that one unit of measure on the map equals 50,000 units of the same measure on the ground. One inch on the map represents 50,000 inches on the ground. On your Tenino map, the scale is **1:50,000.**

Series Number (5)

(Ref: FM 3-25.26, Chapter 3, page 3-1, para 3-1e**(5)**)

You will find the series number in both the upper right margin and the lower left margin. It is a sequence reference expressed either as a four-digit number or as a letter, followed by a three- or four-digit number. The Series Number on your Tenino map is **V791.**

Edition Number (6)

(Ref: FM 3-25.26, Chapter 3, page 3-1, para 3-1f**(6)**)

You will find the edition number in bold print in the upper right area of the top margin and lower left area of the bottom margin. Mapmakers number the editions consecutively; therefore, if you have more than one edition, the highest numbered sheet is the most recent (newest). On your Tenino map, the edition number is **7-DMATC.**

Index to Boundaries (7)

(Ref: FM 3-25.26, Chapter 3, page 3-1, para 3-1g**(7)**)

The index to boundaries diagram appears on the lower or right margin of all map sheets. This diagram, which is a miniature of the map, shows the boundaries that occur within the map area, such as county lines and state boundaries. Note on your Tenino map in the lower right corner, that the **Boundaries Index** depicts a line that separates Thurston County from Lewis County. Look at the Tenino map between latitudes 78 and 79, the dashed line that goes across the entire map just like the one in the **Boundaries Index.**

Adjoining Sheets Diagram (8)

(Ref: FM 3-25.26, Chapter 3, page 3-1, para 3-1h**(8)**)

The adjoining sheet diagram--lower right margin--contains a diagram that illustrates the adjoining sheets to your map sheet. On maps at 1:100,000 and larger scales and at 1:1,000,000 scale, the diagram is called the index to adjoining sheets. The diagram usually contains nine rectangles, but the number may vary depending on the locations of the adjoining sheets. Your Tenino has a total of nine sheets. Note that Tenino Map Sheet Number--1477 IV--is in the center. Should your operations extend out from your Map Sheet, then you will know which map sheet--based on the direction your operation will take you--to use.

Elevation Guide (9)

(Ref: FM 3-25.26, Chapter 3, page 3-1, para 3-1i**(9)**)

The elevation guide normally appears in the lower right margin. It is a miniature characterization of the terrain shown. This map represents the terrain by bands of elevation, spot elevation, and major drainage features. The elevation guide provides the map reader with a means of rapid recognition of major landforms. Note that the **Elevation Guide** is right next to the adjoining sheets diagram.

Declination Diagram (10)

(Ref: FM 3-25.26, Chapter 3, page 3-1, para 3-1j**(10)**)

You will find the declination diagram in the lower margin of large-scale maps. The scale indicates the angular relationships of true north, grid north, and magnetic north. In recent edition maps, there is a note indicating the conversion of azimuths from grid to magnetic and from magnetic to grid next to the declination diagram. These are very important--as you will see later on--in conducting land navigation when you have to convert grid azimuths to magnetic azimuths and magnetic to grid.

Bar Scales (11)

(Ref: FM 3-25.26, Chapter 3, page 3-1, para 3-1k**(11)**)

You will find the bar scale located in the center of the lower margin. The bar-scales are rulers that you use to convert map distance to ground distance. Maps have three or more bar scales, each in a different unit of measure. Take care when using the scales, especially in the selection of the unit of measure that you need. On your Tenino map, there are four scales, meters, yards, statute miles, and nautical miles.

Determine the Grid Coordinates of a Point on a Military Map

Task This section of the RTP teaches--

Task Number:	071-329-1002
Task Title:	Determine the grid coordinates of a point on a military map.
Conditions:	Given a standard 1:50,000-scale military map in a field location, a 1:50,000 grid coordinate scale, a pencil, paper, and a point on the map for which coordinates must be determined.
Standards:	Determine the six-digit grid coordinates for the point on the map with a 100-meter tolerance. Record the grid coordinates with the correct two-letter 100,000-meter-square identifier.

(References: FM 3-25.26, Chapter 4; STP 21-1-SMCT, Oct 94, page 37)

Notes

To keep from getting lost, you have to know how to find out where you are. There are no street addresses in a combat area, but a military map can spot your location accurately. The map has **Vertical Lines** (top to bottom), and **Horizontal Lines** (left to right). These lines form small squares 1,000 meters on each side called **Grid Squares.**

The lines that form grid squares have numbers along the outside edge of the map picture. No two grid squares will have the same number.

We use digits to locate a point on a map. The more digits there are in a coordinate, the more precise the location. You will refresh you memory by covering the four, six, and eight-digit coordinates.

Four-Digit Coordinate

Look at Figure 4 below. Someone tells you that your location is somewhere in grid square 1181. Your first question may be, how do I know where I am?

Begin by reading LEFT to RIGHT (easterly) on your map until you reach **number 11.** You have found the first half of your grid square. Next you read UP (northerly) the map until you reach **number 81.** Now you have the second half of the grid square and your location in a 1000-meter grid square. So, your location is somewhere in grid square 1181.

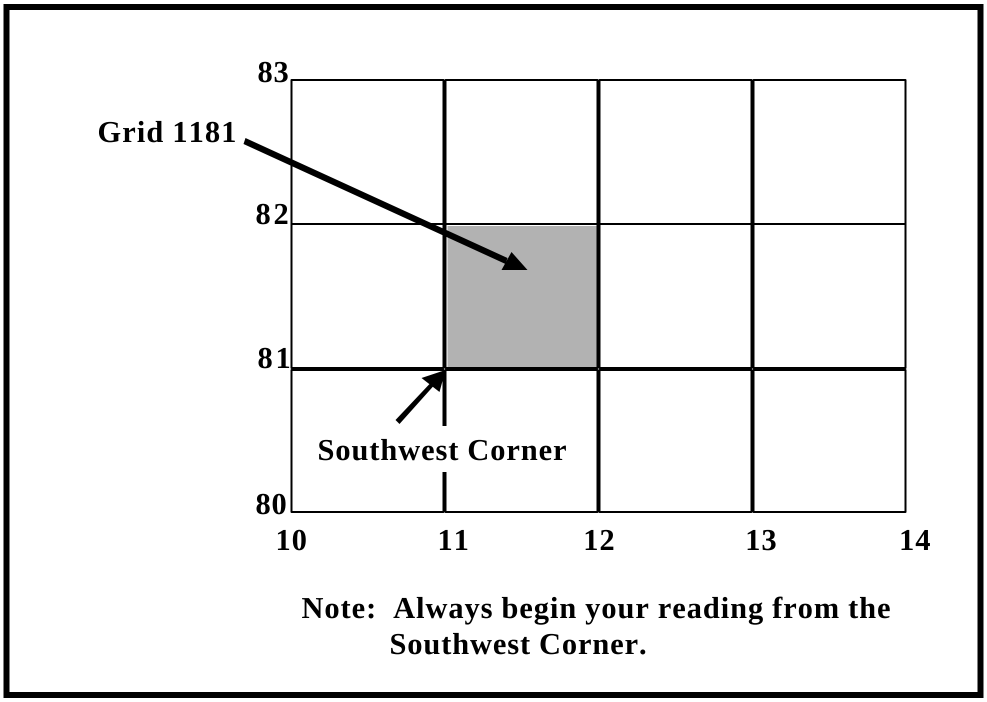


Figure 4

Six-Digit Grid Coordinates

Now that you know you are in grid square 1181, you may want a more precise idea of where you are in this 1000-meter grid square. In other words, you are in the general neighborhood, but it would be nice to determine where your location is within 100 meters. To do this, you just need to add two more numbers, one to the first half (easterly reading 11) and the other number to the second half (northerly reading 81).

To get those extra numbers, imagine that each grid square has ten lines inside spaced evenly running east and west, and another ten lines spaced evenly running north and south. This breaks down the grid square into 100 smaller squares. Now you can estimate where these imaginary lines are and determine where your location is within 100 meters.

Six-Digit Grid Coordinates, continued

Take a look at Figure 5. As you can see, grid zone 1181 breaks down into 100-meter squares.

Suppose you are halfway--about 500 meters--between grid line 11 and grid line 12. Starting at the southwest corner (Ref: Figure 4) of grid square 11, you count from left to right (easterly) (Ref; Figure 5). Since the location is **five,** then you add 5 to the first half of the coordinate (easterly) 11, and it becomes 115.

Now suppose you are approximately 3/10ths--300 meters--of the way between grid line 81 and grid line 82. Starting from grid line 81, you count UP, (northerly) until you reach the 3/10ths--300-meter point (Ref: Figure 5). Since the location is **three,** then you add 3 to the second half of the coordinate (northerly) 81, and it becomes 813. So, your six-digit grid is 115813 as shown in Figure 5.

In another example, if you are exactly on line 11, then the first half coordinate (easterly) would be 110, and if you are exactly on line 81, then the second half of the coordinate (northerly) would be 810. Then the six-digit grid is 110810.

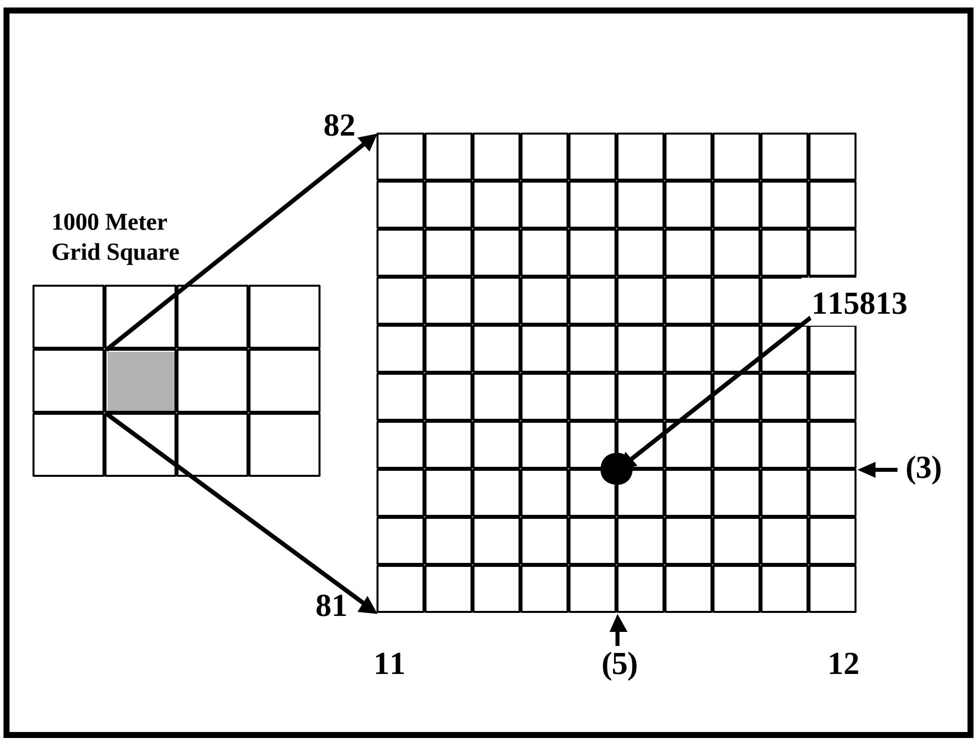
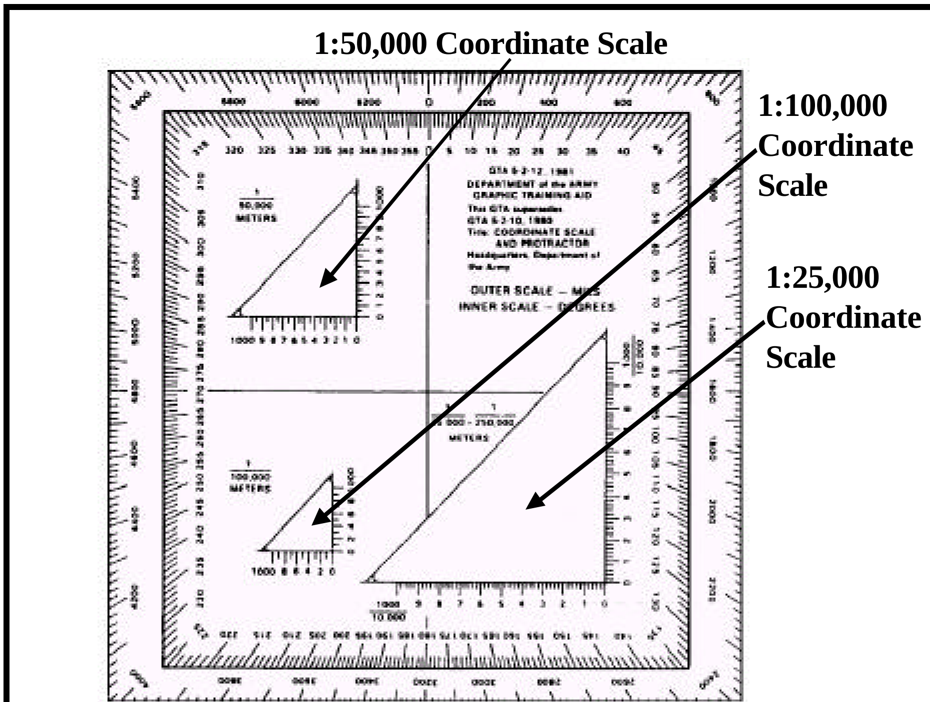


Figure 5

Coordinate Scale

The most accurate way to determine the coordinate of a point on a map is to use a coordinate scale. With the coordinate scale, you don't have to use imaginary lines because the coordinate scale will give you the exact coordinates. This scale is on the Coordinate Scale and Protractor--GTA 5-2-12--see Figure 6 below.



Coordinate scale and protractor, GTA 5-2-12

Figure 6

Six-Digit Grid Coordinates Using Coordinate Scale

As you can see, the protractor has three coordinate scales: 1:25,000, 1:50,000 and 1:100,000. Make sure that when you use the coordinate scale that you use the proper one based on the scale of your map. For the PLDC course, you will be using 1:50,000 scale maps.

Let's locate a point on a grid square using the coordinate scale, Figure 7, page RTP-12.

1. Locate the four-digit grid square of Point A.
2. Read RIGHT and UP, you should have a four-digit grid of 1181.
3. Place the coordinate scale on the bottom horizontal grid line (81) of the grid square containing Point A to determine the third and sixth digits of the coordinate.

Six-Digit Grid Coordinates Using Coordinate Scale

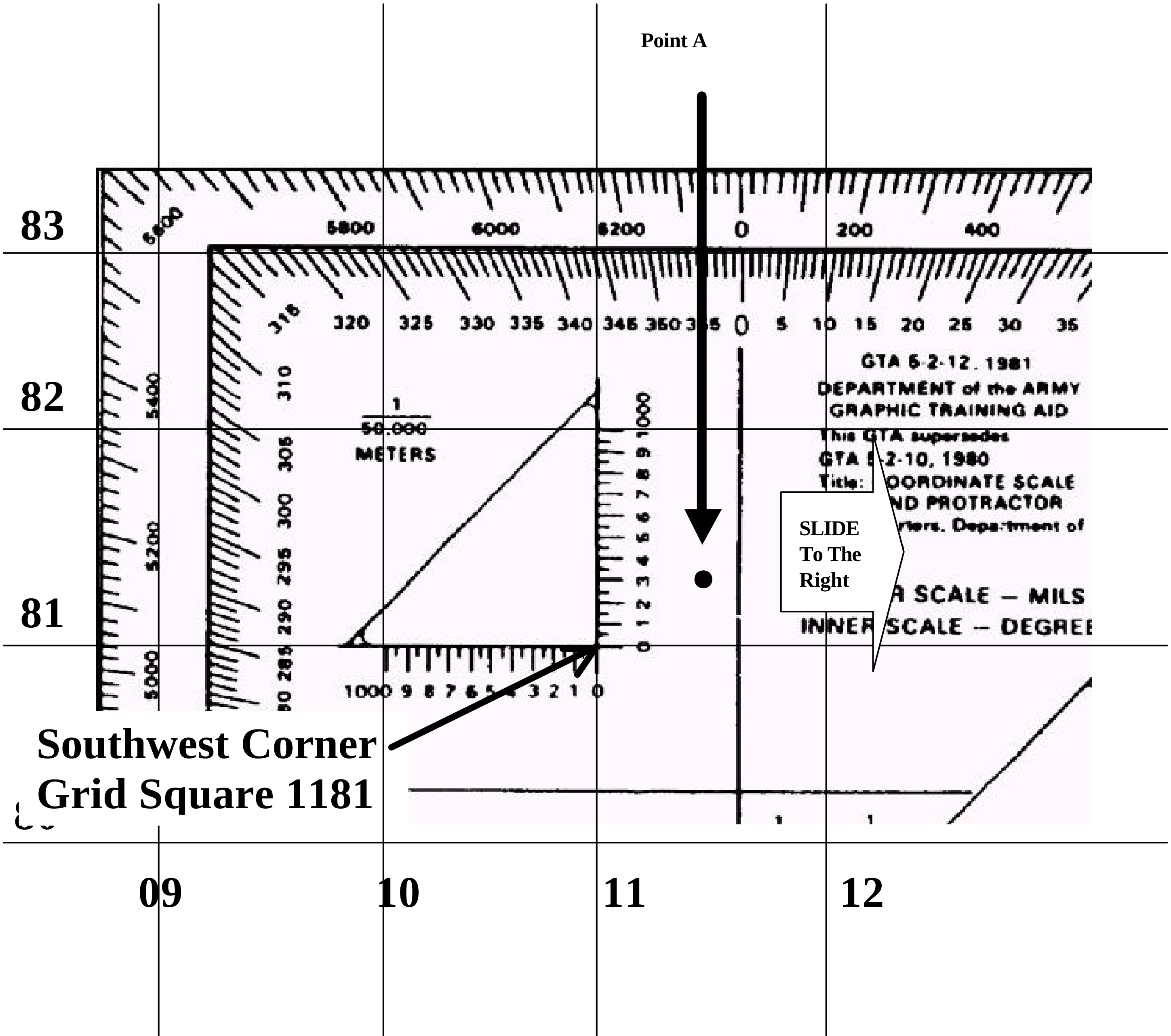


Figure 7

4. Place the coordinate scale so that the **ZEROS** of the coordinate scale are in the lower left-hand **(southwest corner)** of grid square 1181, the grid square containing Point A, Figure 7.

Six-Digit Grid Coordinates Using Coordinate Scale, continued

5. Slide the scale to the right, keeping the bottom of the scale on the bottom grid line (81), until Point A is under the vertical (right-hand) scale, Figure 8.

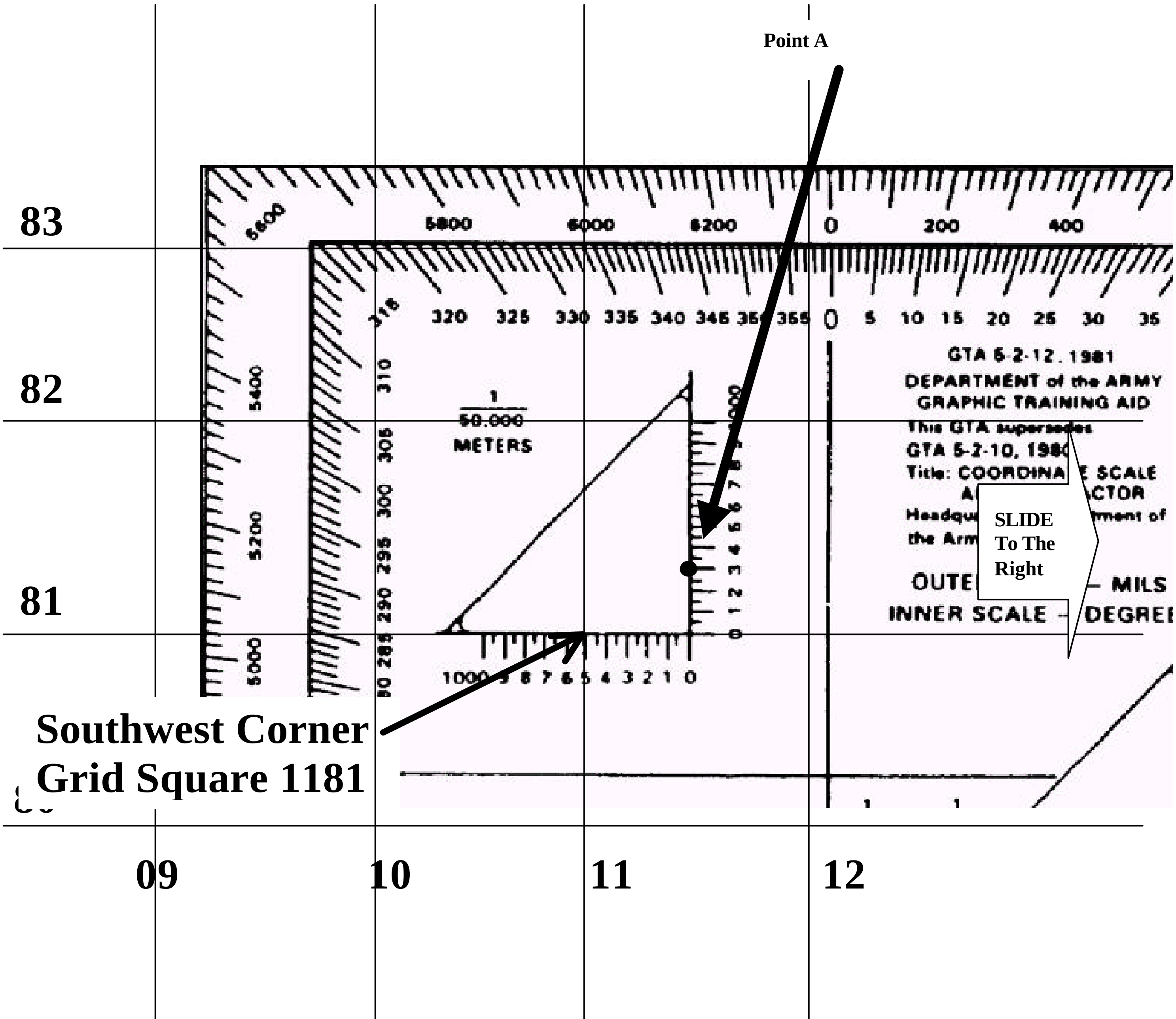


Figure 8

Six-Digit Grid Coordinates Using Coordinate Scale, continued

6. To find the third-digit for the first half (easterly) grid coordinate, go to grid line 11. There, as you see in Figure 8, grid line 11 runs through the number five on the bottom line of the coordinate scale. Five becomes your third number for grid 11 (easterly), so the first half of the grid coordinate is 115.

7. To find the third-digit for the second half (northerly) grid coordinate, go to grid line 81. As you can see in Figure 8, Point A on the map is right under the number 3 (vertical scale) on the coordinate scale. The 3 becomes your third number for grid 81 (northerly), so the second half of the grid coordinate is 813.

8. You have now determined your location on the map to within 100 meters as 115813.

Eight-Digit Grid Coordinates Using Coordinate Scale

To determine an eight-digit coordinate, which will locate a point on the ground to within 10 meters, you must keep in mind that there are 100 meters between each 100-meter mark (number) on the coordinate scale. As you may have already noticed, the coordinate scale has short tickmarks to indicate 50 meters between each 100-meter mark. See Figure 9.

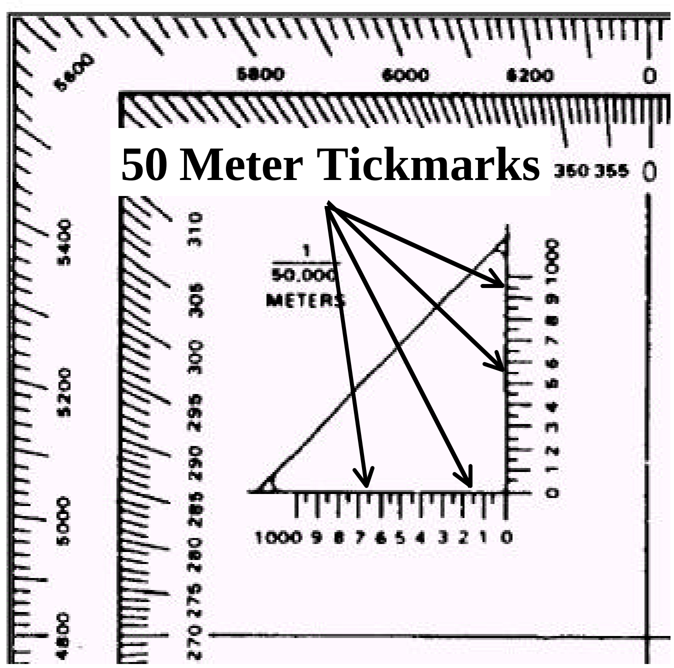


Figure 9

Determine an Eight-Digit Grid Coordinates Using Coordinate Scale

To find the eight-digit coordinate, you use the same procedures as those used to find the six-digit coordinate using the coordinate scale. If the point on the map lies at a spot where the vertical grid line falls between two 100-meter marks on the horizontal scale of the coordinate scale, and between two 100-meter marks on the vertical scale of the coordinate scale, then you interpolate (estimate) the distance, Figure 10.

To determine the four digits of the first half of the grid coordinate, you can see where grid line 11 runs through the number 5 (500-meter mark) on the horizontal scale of the coordinate scale. Since the line runs right through the 5, then the third number is 5, and the fourth number is 0. So, the first half of the grid coordinate is 1150.

To determine the four digits of the second half of the grid coordinate, you can see where Point A lies between the number 5 (500-meter mark) and the 50 meter tickmark that lies between numbers 5 and 4 (400-meter mark) on the vertical scale of the coordinate scale. The third number of the second half of the grid coordinate will be 4. To determine the fourth number of the second half, you must interpolate (estimate) the distance between the 50 meter tickmark and the number 5 in 10 meter increments. In this case the estimate is 30 meters from the 50 meter tickmark. So, the second half of the grid coordinate is 8148.

The eight-digit grid coordinate for Point A on Figure 10 then reads as **11508148.**

100,000-Meter Square Identifier

The last thing in determining a grid coordinate is to place the correct 100,000-meter square identifier in front of your four, six, or eight-digit grid coordinate. You can find the 100,000-meter square identifier, made up of two letters, in the lower center margin of your map in the grid reference box, Figure 11, page 17.

As you can see in the grid reference box, the 100,000 meter square identification is in the left column center, identified as:

$$\frac{\textbf{EH}}{\textbf{EG}}\quad {}^{52}\mathbf{00}$$

Take out your Tenino map, and find the grid reference box. Notice that the 100,000-meter square identification is the same as above, and that the grid reference box is the same as Figure 11, page RTP-17.

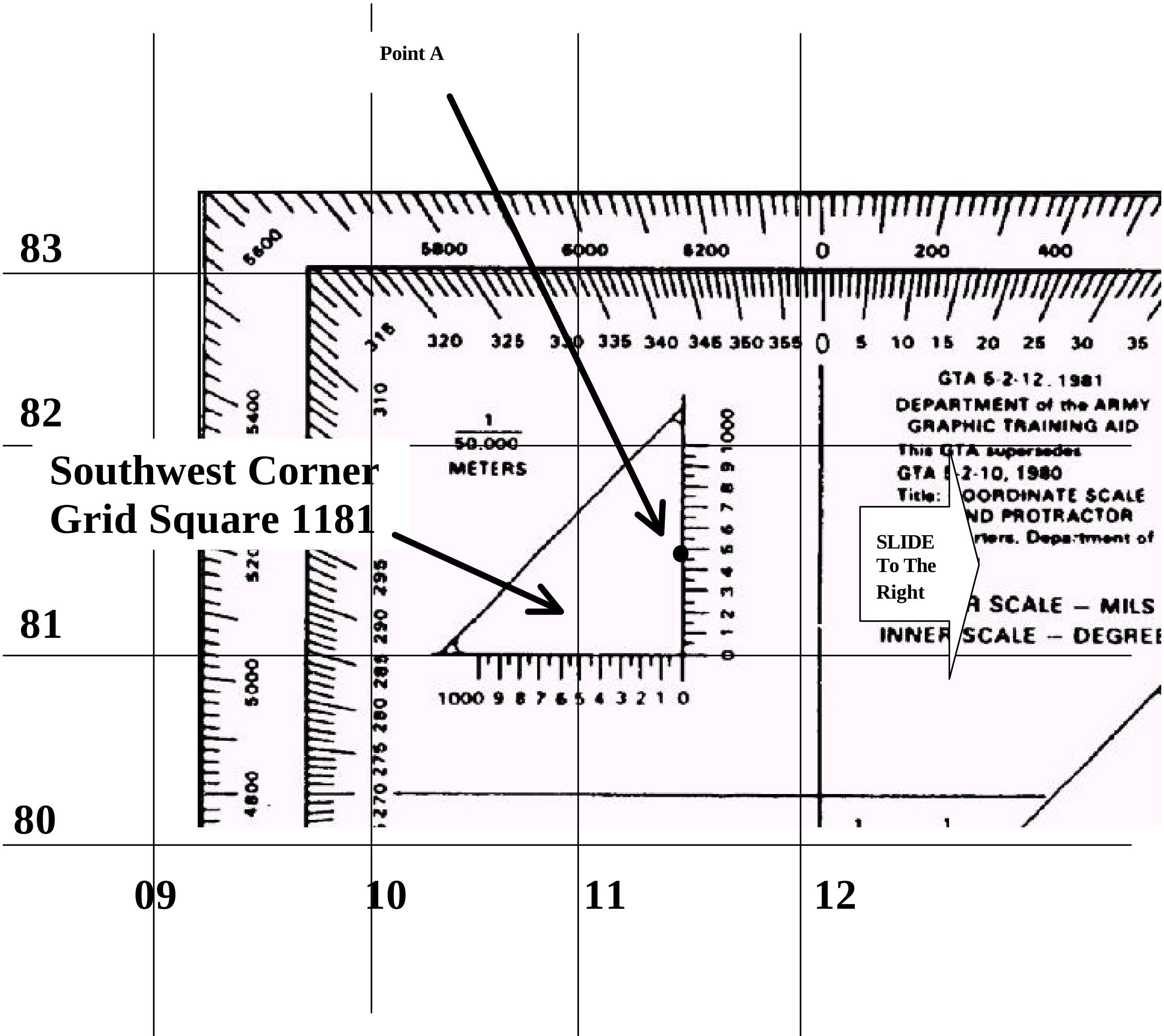

Point A
83
82
81
80
09
10
11
12
Southwest Corner
Grid Square 1181
SLIDE
To The
Right
GTA 5-2-12, 1981
DEPARTMENT of the ARMY
GRAPHIC TRAINING AID
1
50,000
METERS

Figure 10

100,000-Meter Square Identifier, continued

Don't let the EH over the EG confuse you. What this indicates is that the Tenino map happens to fall within two different 100,000-meter map squares. The numbers to the right ($^{52}00$) tell you where on your map the division between the two 100,000-meter map squares are. Since the EH is over the EG--as shown below--separated by a horizontal line, the division is on grid line 00 that runs east and west. If the grid reference was shown with the **EH** and **EG** beside each other with a vertical line between them, then the division would have been on Grid Line 00 running north and south.

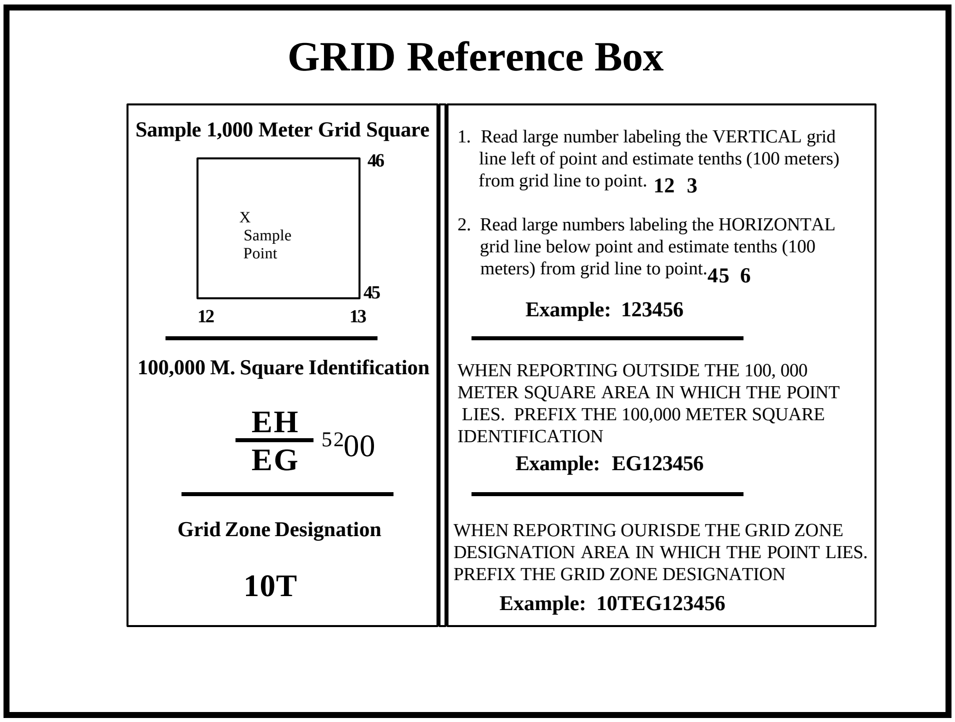


Figure 11

The significance of this is that all coordinates above the 00 grid line running east and west will begin with the letters EH and all coordinates below the 00 grid line running east and west will begin with the letters EG. For Example: On your Tenino Map:

EH0401, See the two ponds?
EH053045, See the lake?
EG0493, See Maytown?
EG086958, See Pitman Lake?

Without the EH or EG, when you report locations, the people who receive your report would not know which 100,000-meter map square you are reporting about.

Identify Terrain Features on a Map

Task

This section of RTP teaches--

Task Number:	071-329-1001
Task Title:	Identify terrain features on a map.
Conditions:	Given a standard 1:50,000-scale military map.
Standards:	Identify the five major and three minor features on the map.

(References: FM 3-25.26, Chapter 10; STP 21-1-SMCT, Oct 94, page 28)

Identify Terrain Features

You identify terrain features in the same manner on all maps, regardless of the coutour interval, but you must realize that a hill in the Rocky Mountains will be much bigger than the one in south Florida. You must be able to recognize all the terrain features to locate a point on the ground or to navigate from one point to another.

Terrain Features

Mapmakers derived all terrain features from a complex landmass known as a mountain or ridgeline (Figure 12). The term ridgeline is not interchangeable with the term ridge. A ridgeline is a line of high ground, usually with changes in elevation along its top and low ground on all sides. It is from the ridgeline that mapmakers have classified a total of 10 natural or man-made terrain features. These features break down into five major, three minor, and two supplementary features.

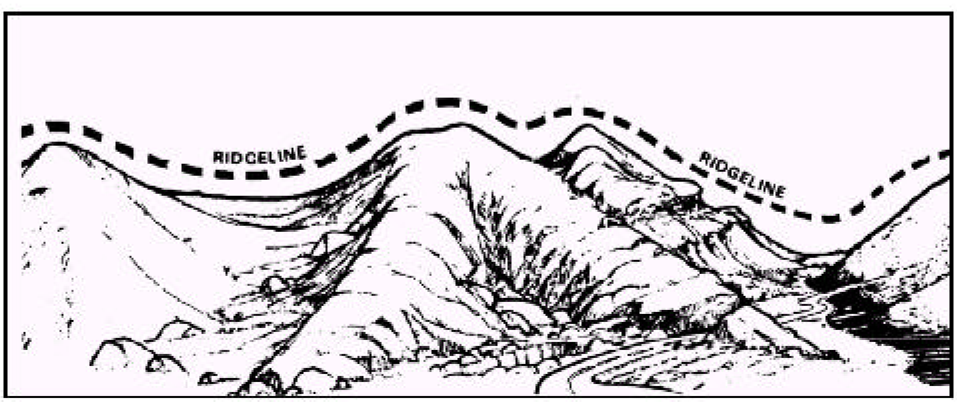


Figure 12

Five Major Terrain Features

1. Hill. A hill is an area of high ground. From a hilltop, the ground slopes down in all directions. A map depicts a hill by showing contour lines forming concentric circles (circles having a common center). The inside of the smallest closed circle is the hilltop, Figure 13.

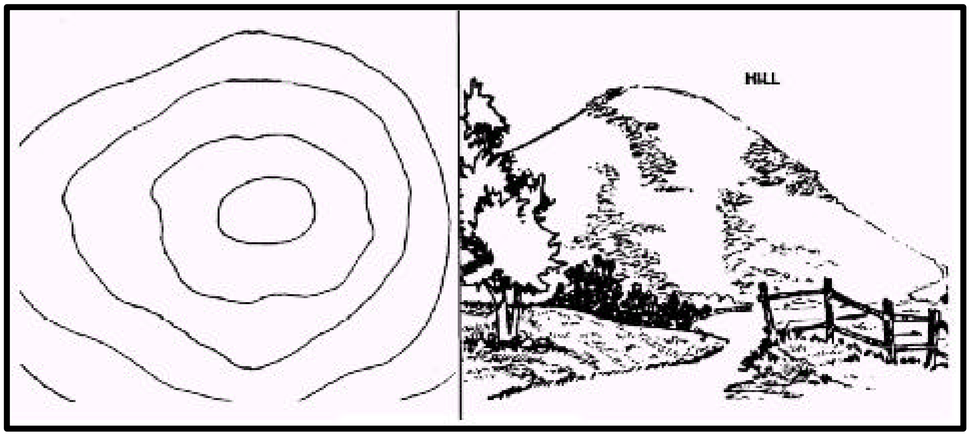


Figure 13, Hill

2. Saddle: A saddle is a dip or low point between two areas of high ground. A saddle is not necessarily the lower ground between two hilltops; it may be simply a dip or break along a level ridgecrest. If you are in a saddle, there is high ground in two opposite directions and lower ground in the other two directions. An hourglass normally represents a saddle. Figure 14.

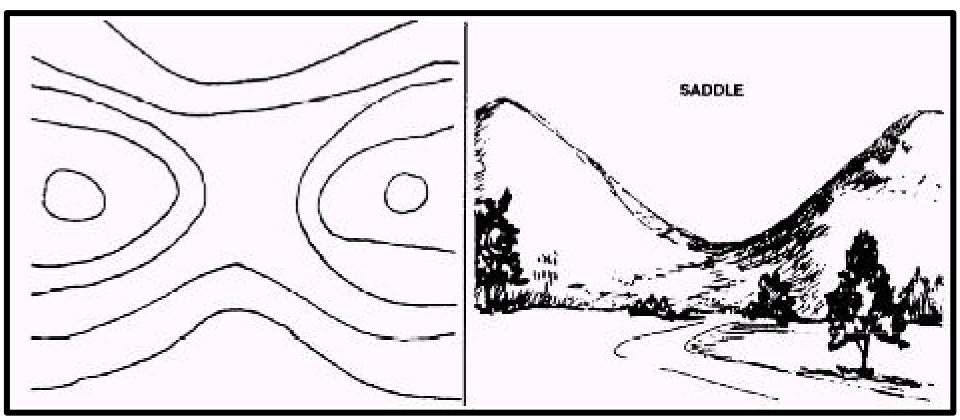


Figure 14, Saddle

3. Valley. A valley is a stretched-out groove in the land, usually formed by streams or rivers. A valley begins with high ground on three sides, and usually has a course of running water through it. If standing in a valley, there is high ground in two opposite directions and there is a decline from the third direction to the fourth. Depending on its size and where a

Five Major Terrain Features, continued

a person is standing, it may not be obvious that there is high ground in the third direction, but water flows from higher to lower ground. Contour lines forming a valley are either U shaped or V shaped. To determine the direction water is flowing, look at the coutour lines. The closed end of the contour line (U or V) always points upstream or toward high ground, Figure 15.

Figure 15, Valley

4. Ridge. A ridge is a sloping line of high ground. If you are standing on the centerline of a ridge, you will normally have low ground in three directions and high ground in one direction with varying degrees of slope. If you cross a ridge at right angles, you will climb steeply to the crest and then descend steeply to the base. When you move along the path of the ridge, depending on the geographic location, there may be either an almost unnoticeable slope or a very obvious incline. Contour lines forming a ridge tend to be U-shaped or V-shaped. The closed end of the contour line points away from high ground, Figure 16.

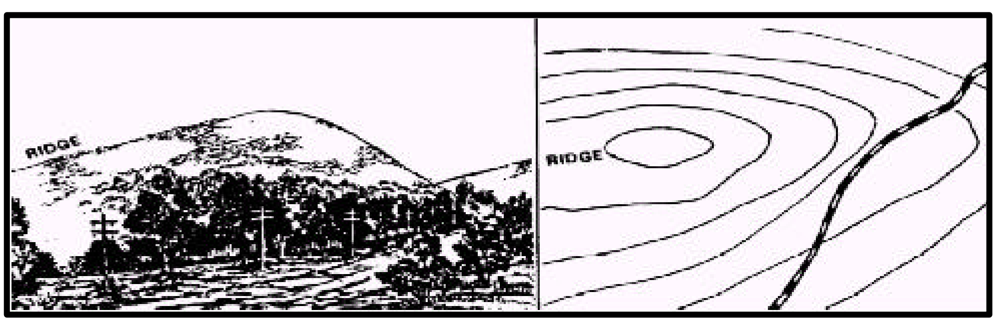


Figure 16, Ridge

Five Major Terrain Features, continued

5. Depression. A depression is a low point in the ground or a sinkhole. One could describe it as an area of low ground surrounded by higher ground in all directions, or simply a hole in the ground. Usually mapmakers only show depressions that are equal to or greater than the contour interval. Maps show depressions by closed contour lines that have tickmarks pointing toward low ground, Figure 17.

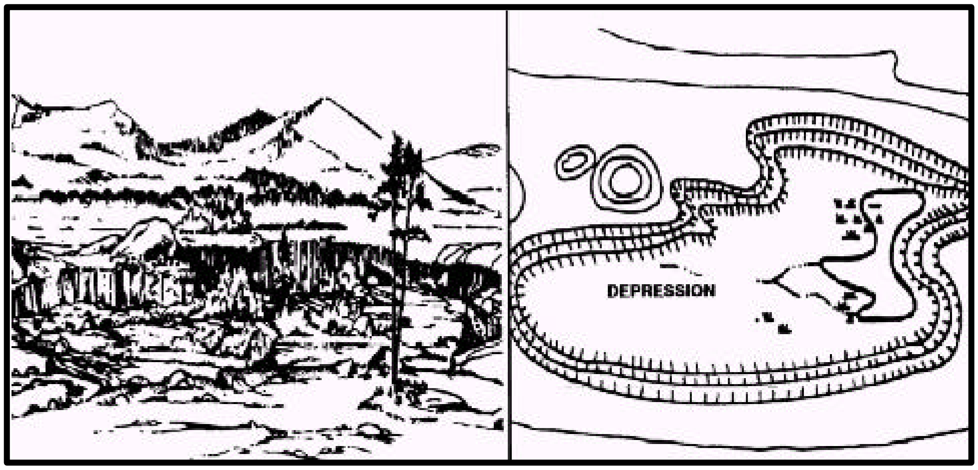


Figure 17, Depression

Three Minor Terrain Features

1. Draw. A draw is a less developed stream course than a valley. In a draw, there is essentially no level ground and, therefore, little or no maneuver room within its confines. If you are standing in a draw, the ground slopes upward in three directions and downward in the other direction. You can consider a draw as the initial formation of a valley. The contour lines depicting draws are U-shaped or V-shaped, pointing toward high ground, Figure 18.

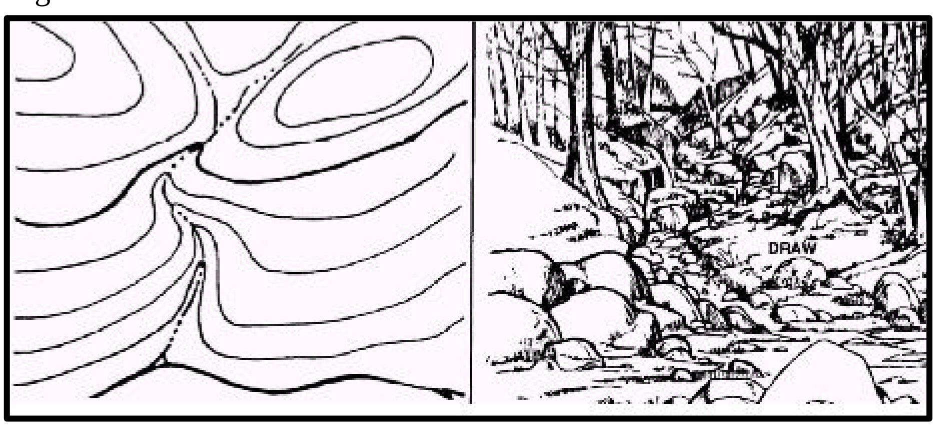


Figure 18, Draw

Three Minor Terrain Features, continued

2. Spur. A spur is a short, continuous sloping line of higher ground, normally jutting out from the side of a ridge. A spur often forms when two roughly parallel streams cut draws down the side of a ridge. The ground will slope down in three directions and up in one. Contour lines on a map depict a spur with the U or V pointing away from high ground, Figure 19.

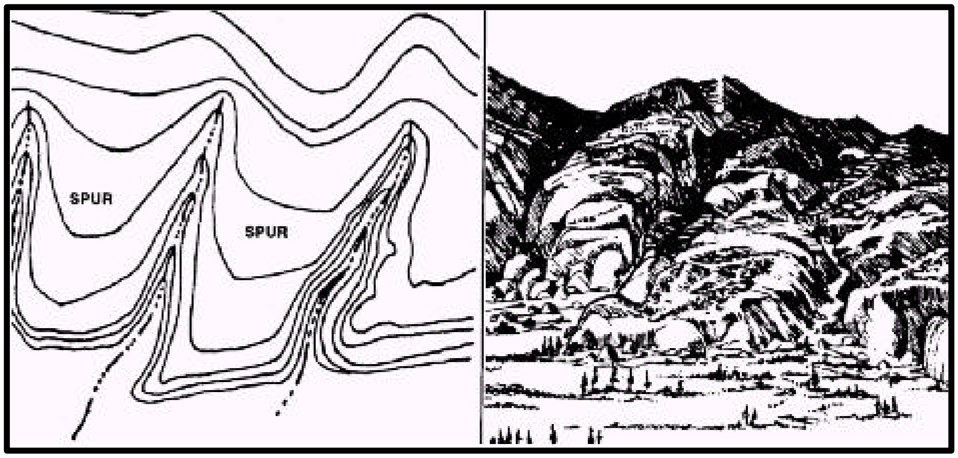


Figure 19, Spur

3. Cliff. A cliff is a vertical or near vertical feature; an abrupt change of the land. When a slope is so steep that the contour lines converge into one "carrying" contour of contours, this last contour line has tick marks pointing toward low ground, Figure 20.

Figure 20, Cliff (With Tick Marks)

Three Minor Terrain Features, continued

Maps also depict cliffs by showing contour lines very close together and, in some instances, touching each other, Figure 21.

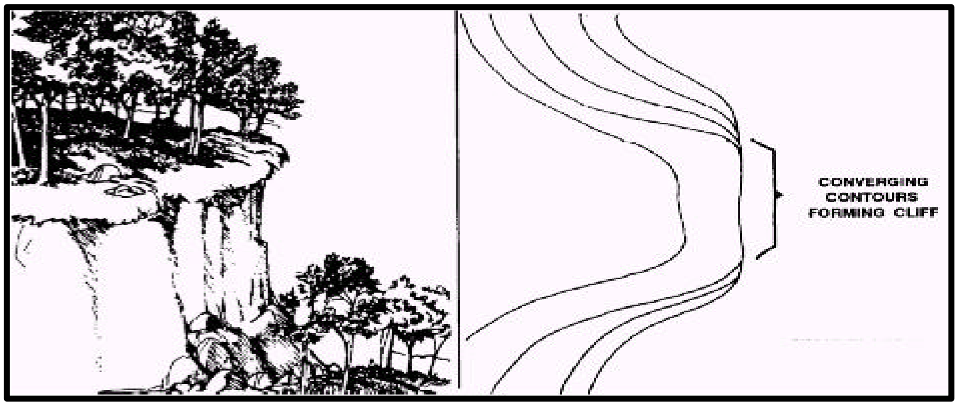


Figure 21, Cliff with Converging Contours

Two Supplementary Terrain Features.

1. Cut. A cut is a man-made feature resulting from cutting through raised ground, usually to form a level bed for a road or railroad track. Maps identify cuts when they are at least 10 feet high, and they appear with a contour line along the cut line. This contour line extends the length of the cut and has tick marks that extend from the cut line to the roadbed, if the map scale permits this level of detail, Figure 22.

2. Fill. A fill is a man-made feature resulting from filling a low area, usually to form a level bed for a road or railroad track. Maps depict fills when they are at least 10 feet high; they appear with a contour line along the fill line. This contour line extends the length of the filled area and has tick marks that point toward lower ground. If the map scale permits, the length of the fill tickmarks--drawn to scale--extend from the base line of the fill symbol, Figure 22.

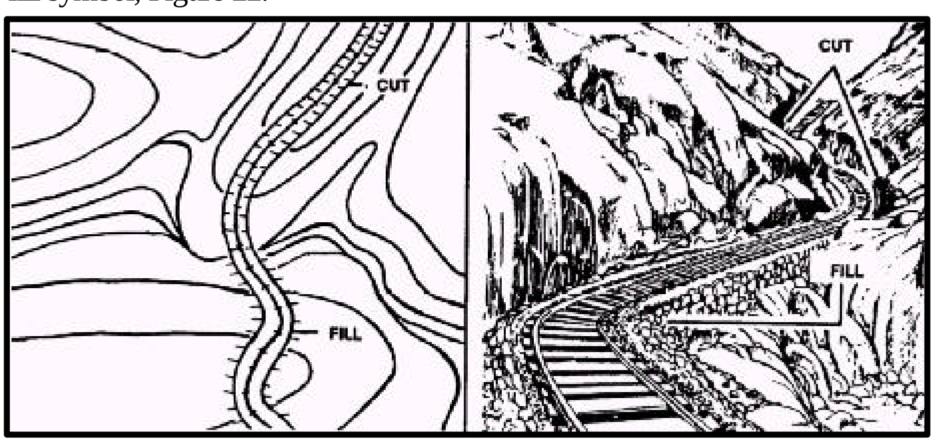


Figure 22, Cut and Fill

Terrain Features

Figure 23 provides you with a map with all the terrain features you just covered.

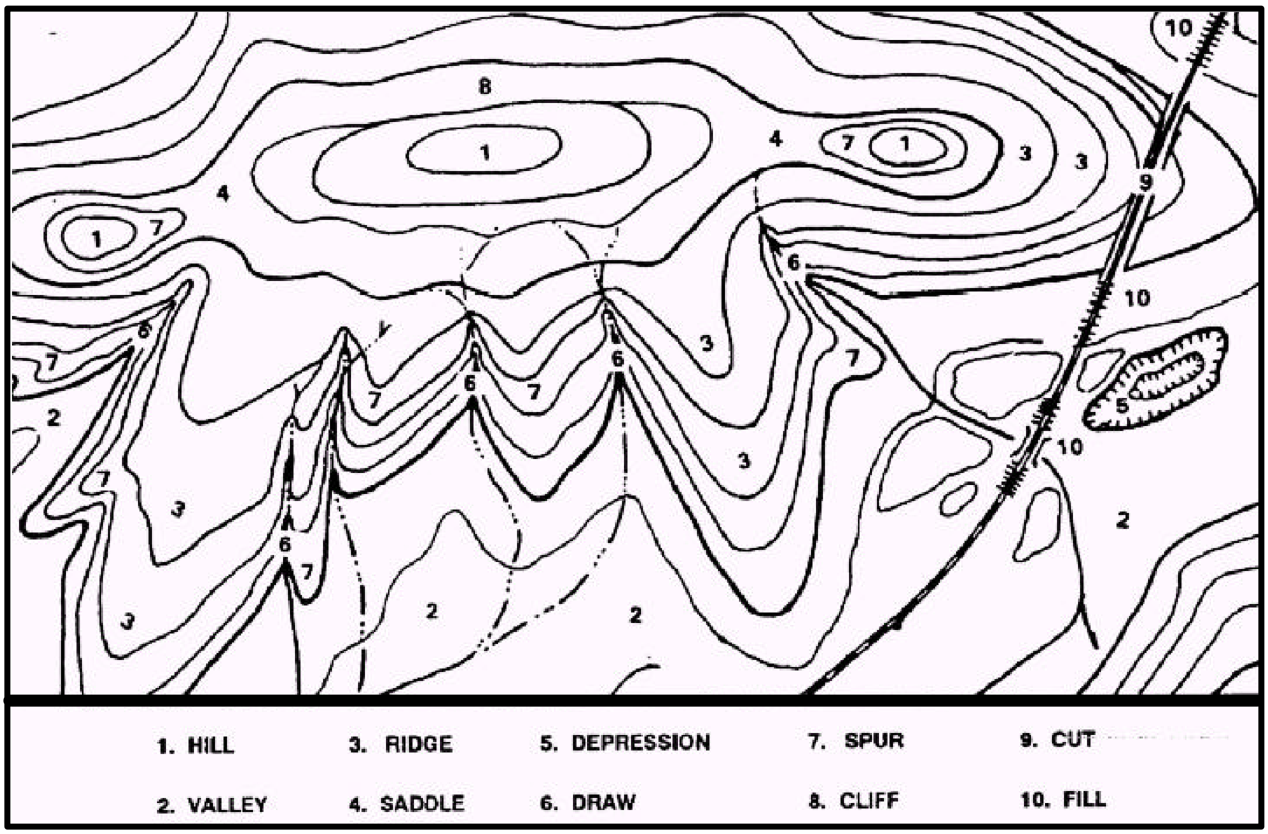


Figure 23

Determine a Magnetic Azimuth using a Lensatic Compass

Task This section of the RTP teaches--

Task Number:	071-329-1003
Task Title:	Determine a magnetic azimuth using a lensatic compass.
Conditions:	Given a compass and a designated point on the ground.
Standards:	Determine the correct magnetic azimuth to the designated point within 3 degrees using the compass-to-cheek method, and within 10 degrees using the center-hold method.

(References: FM 3-25.26, Chapter 9; STP 21-1-SMCT, Oct 94, page 45)

The Lensatic Compass

The lensatic compass, Figure 24, consists of three major parts: the cover, the base, and the lens or rear sight.

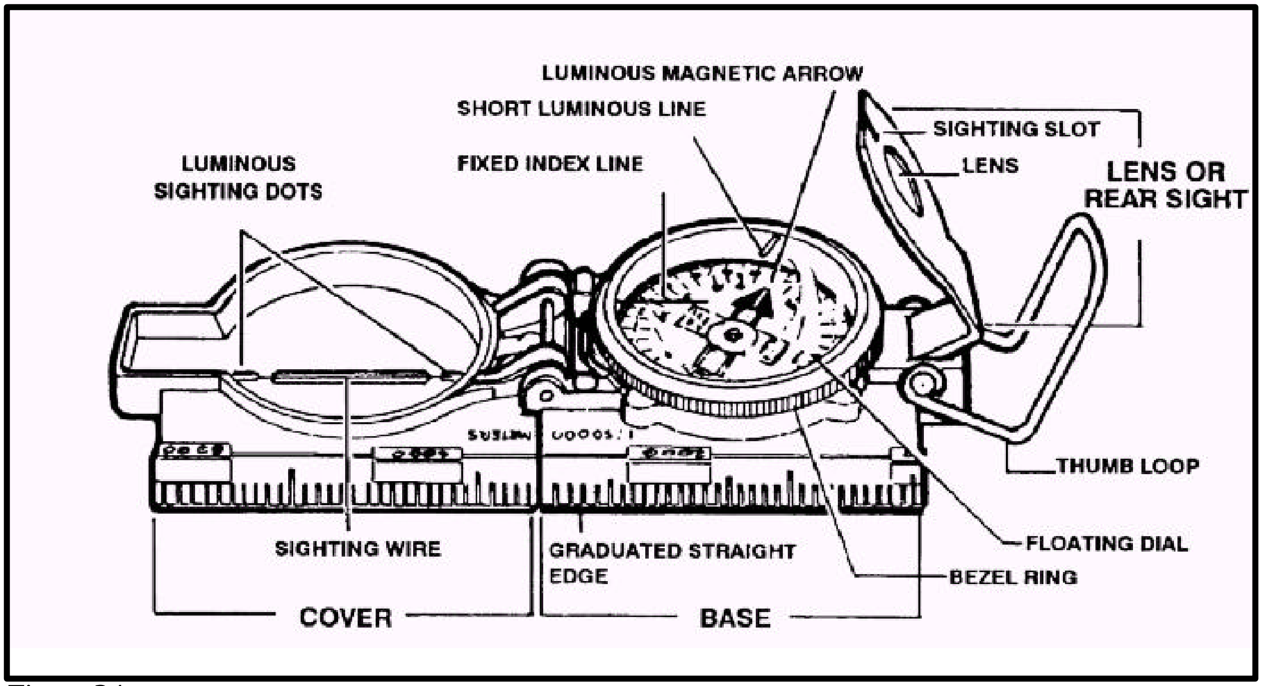


Figure 24

A. Cover: The compass cover protects the floating dial. It contains the sighting wire (front sight) and two luminous sighting slots or dots used for night navigation.

The Lensatic Compass, continued

B. Base: The body of the compass contains the following movable parts:

1. Floating Dial, Figure 25. Used to determine the direction in which you point your compass. The dial, mounted on a pivot, rotates freely when you hold the compass level. Printed on the dial in luminous figures are an arrow and the letters E and W. The arrow always points to magnetic north and the letters (E) east 90^{o} and (W) west 270^{O} are on the dial.

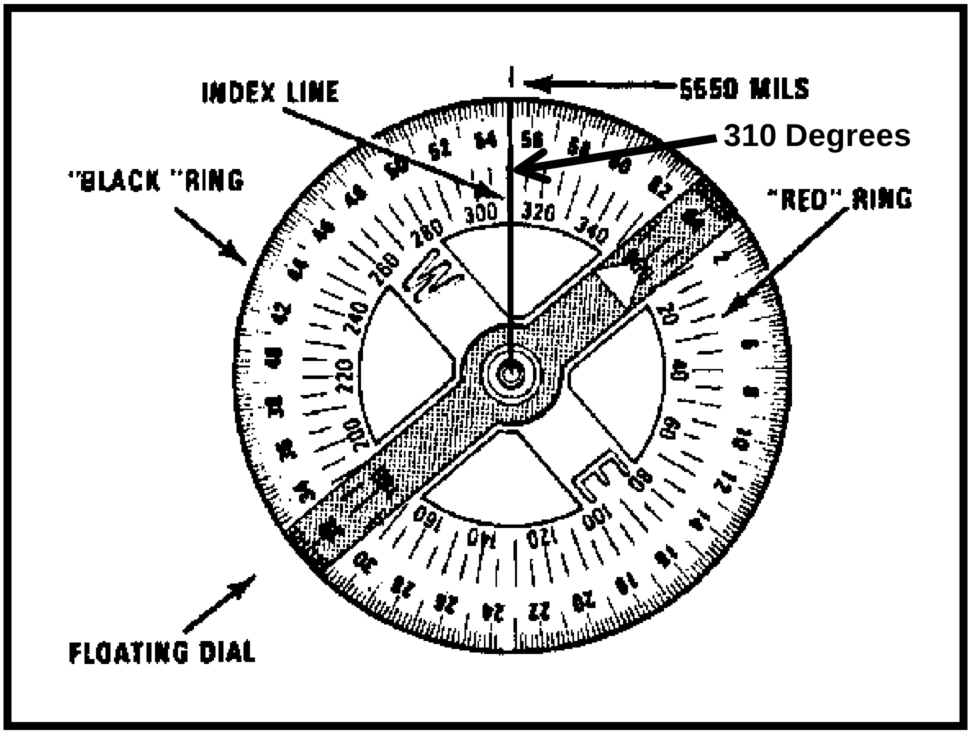


Figure 25

There are two scales; the outer in black numbers denotes mils and the inner numbers (normally in red) denotes degrees.

2. Encasing the floating dial is a glass containing a fixed black index line, Figures 24 and 25.

3. The bezel ring is a ratchet device that clicks when turned. It contains 120 clicks when rotated fully; each click is equal to 3^{o}. The glass face of the bezel ring contains a short luminous line that you use in conjunction with the north-seeking arrow during navigation, Figure 24.

4. The thumb loop is attached to the base of the compass, Figure 24.

The Lensatic Compass, continued

C. Lens or Rear Sight: You use the lens to read the dial. Above the lens is the rear-sight slot used in conjunction with the front for sighting on objects. The rear sight also serves as a lock and clamps the dial when closed for its protection. You must open the rear sight more than 45^{o} to allow the dial to float freely, Figure 24.

Care of the Compass

As soon as you get your compass, inspect it in detail. One of the most important parts is the floating dial that contains the magnetic needle. Make sure that the dial floats freely and DOES NOT STICK. Also, make sure the sighting wire is straight, the glass and crystal parts are not broken, and you can read all the numbers on the dial.

Metal objects and electrical sources have an effect on the performance of a compass. However, nonmagnetic metals and alloys do not affect compass readings. Maintain the following separation distances when using a compass:

High-tension power line…………..55 meters.
Field gun, truck, or tank…………..18 meters.
Telegraph or telephone wire and
barbed wire……………………..10 meters.
Machine gun………………………..2 meters.
Steel helmet or rifle 1/2 meter.

Your compass, if in good working condition, is very accurate. However, you must check your compass periodically to ensure it works properly. Check it by using it on a known line of direction, such as a surveyed azimuth using a declination station. Do no use a compass with more than a 3^{o} + variation.

Note: The NCOA should have some locations in the NCOA area where you can test the accuracy of your compass. Check with your SGL.

When you travel with the compass unfolded, make sure you fold down the rear sight all the way to the bezel ring. This will lock the floating dial and prevent vibration, as well as protect the crystal and rear sight from damage.

Shooting an Azimuth

1. Use the floating dial to determine the direction in which you are pointing your compass.

2. Use the outer black ring of numbers and tick marks for finding directions in mils, Figure 25.

Shooting an Azimuth

3. Use the inner red ring of numbers and tick marks for finding direction in degrees, Figure 25.

a. There are 360 degrees (inner red ring) and 6,400 mils (outer black ring) in a circle. The compass depicts the degrees at 5 degree intervals and depicts the mils at 20 mil intervals. For the lines in degrees and mils that do not have a number, you will have to determine the line's number using the numbers given on the dial.

Note: In Figure 25, the dial is resting with the **index line** over 5,550 mils and 310 degrees.

Note: You will use the degree ring (inner red ring) for this course.

b. To read direction, point the compass in the direction you want to go or want to determine.

c. Look beneath the index line on the outer glass cover and estimate to the nearest degree or 10 mils the position of the index line over the Red (degree) or black (mils) scale.

d. Be careful to hold the compass still so that the dial remains stationary while you read the scale.

Note: If you understand these readings and can apply either of the holding and sighting techniques of shooting an azimuth, you will be proficient in performing this task.

4. Use the compass to determine or follow an azimuth. The arrow on the compass points toward magnetic north. The arrow is also attracted by any mass of metal; for example, a truck, your rifle, and even electrical power lines. Thus, be sure you use your compass away from metal objects so it will not give a wrong reading.

5. Always hold the compass level and firm when sighting on an object and reading an azimuth.

Compass Holding Methods

There are two methods to holding and reading a compass.

NOTE: At this time you will need your compass that the NCOA issued to you.

A. Compass-to-Cheek Method: (Figure 26)

1. Open the cover to a 90-degree angle to the base. Position the eyepiece at a 45-degree angle to the base.

Figure 26, Compass-to-Cheek Method

Compass Holding Methods, continued

2. Place your thumb through the thumb loop, form a steady base with your third and fourth fingers, and extend your index finger along the side of the compass base.

3. Place the hand holding the compass into the palm of the other hand.

4. Bring both hands up to your face and position the thumb that is through the loop against your cheekbone.

5. Look through the lens of the eyepiece. If the dial is not in focus, move the eyepiece up or down until the dial is in focus. Don't forget that the lens/rear sight must be at a 45^{o} angle to ensure the dial floats freely.

6. Align the sighting slot of the eyepiece with the sighting wire in the cover on the point for which your are trying to determine the azimuth, Figure 27.

Compass Holding Methods, continued

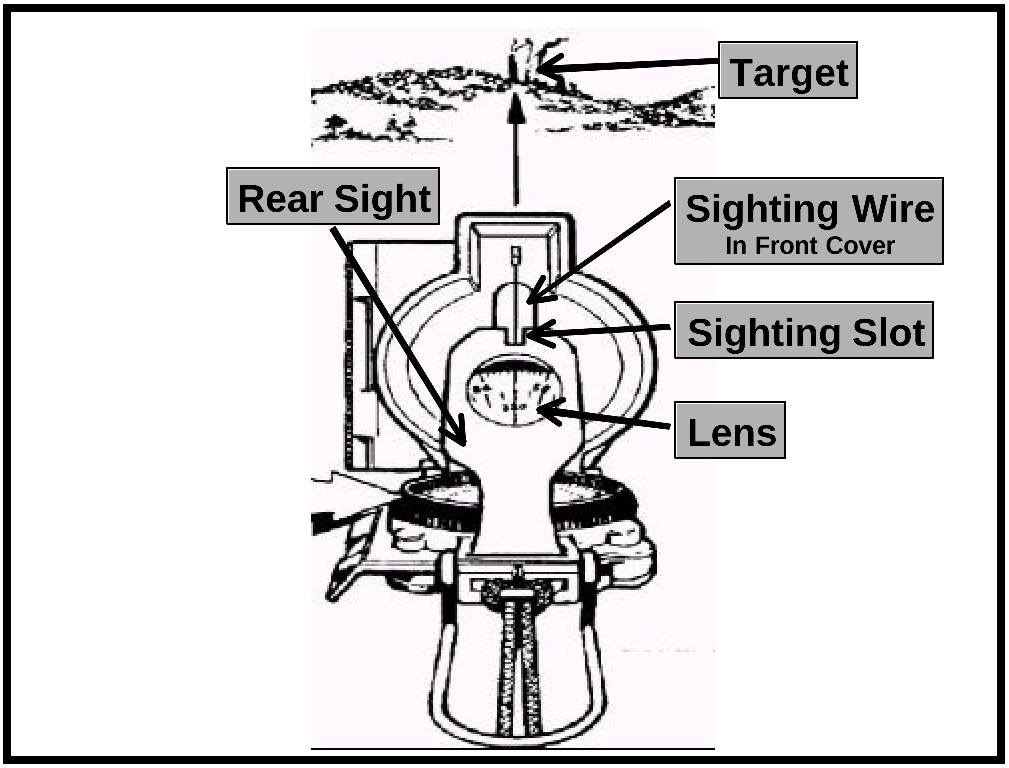


Figure 27

B. Centerhold Method (Figure 28)

Note: Use this method only when you don't need a precise direction.

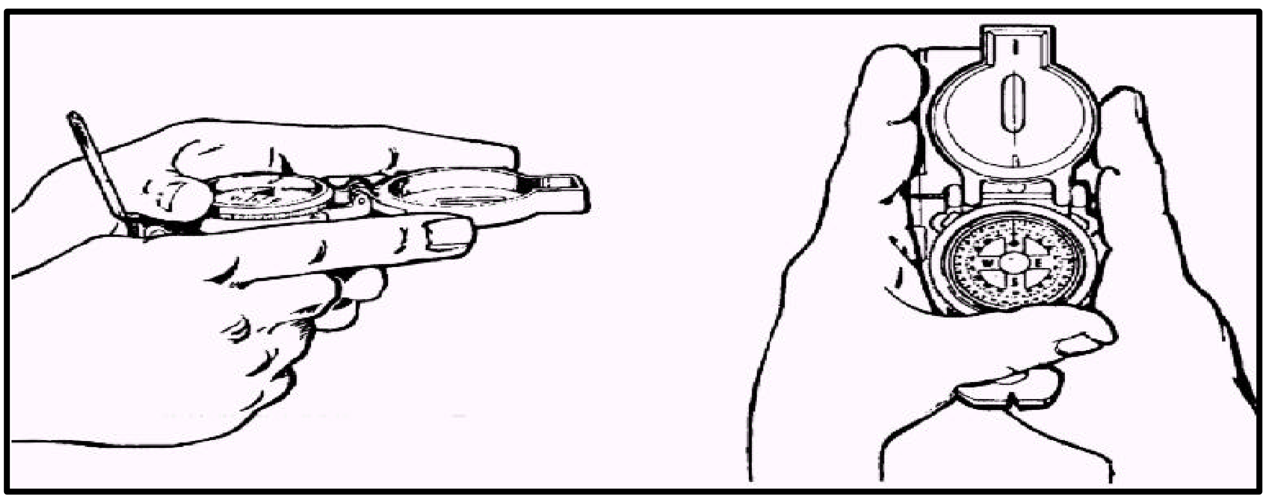


Figure 28, Centerhold Method

1. Open the compass so that the cover forms a straight edge with the base. Move the lens/rear sight to the rear as far as it will move.

Compass Holding Methods, continued

2. Next, place your thumb through the thumb loop, form a steady base with your third and fourth fingers, and extend your index finger along the side of the compass.

3. Place the thumb of the other hand between the eyepiece and the lens, extend the index finger along the remaining side of the compass, wrap the remaining fingers around the fingers of the other hand, and pull your elbows firmly into your sides. This will place the compass between your chin and your belt.

4. To measure an azimuth, you must turn your entire body toward the object and point the compass cover directly at the object. Look down and read the azimuth from beneath the fixed black index line. You may use this method at night.

5. To keep from going in circles when you are land navigating, stop occasionally to check the azimuth along which you are moving. Also, you can move from object to object along your path by shooting an azimuth to each object and then moving to that object. Repeating this process while you navigate should keep you straight.

Measure Distance on a Map

Task

This section of the RTP teaches--

Task Number:	071-329-1008
Task Title:	Measure distance on a map.
Conditions:	Given a standard 1:50,000-scale military map, a strip of paper with a straight edge, and a pencil.
Standards:	1. Determine the straight-line distance, in meters, between two points, with no more than 5 percent error. 2. Determine the road (curved line) distance, in meters, between two points, with no more than 10 percent error.

(References: FM 3-25.26, Chapter 5; STP 21-1-SMCT, Oct 94, page 53)

Determining Distance on a Map

If you were to plot the coordinates to two points, one inch apart on your 1:50,000-scale map, your first thought might be--this isn't very far. However, once you convert the one-inch of map distance to actual distance you must travel on the ground, you will discover that your trip, at a minimum, would be 1,270 meters long!

A definite relationship exists between the distance of points on the map and the distance between the same points on the ground. Normally, we express this relationship in one of two ways: by a representative fraction or by a graphic scale.

A representative fraction (RF) is the numerical scale of a map (on your Tenino map it is 1:50,000). Keep in mind, RF expresses the ratio of horizontal distance on the map to the corresponding horizontal distance on the ground. You always write the RF with the map distance as one (1) and in either linear form (1:50,000) or fraction form 1/50,000.

An RF written in either form simply means that one unit of measure on the map is equal to (on your Tenino map) 50,000 of the same units on the ground. For example, one-inch (1") map distance (MD) measured on a map scaled at 1:50,000 is equal to 50,000 inches of ground distance (GD).

Determining Distance on a Map

If you don't like working with inches, you can convert to other units of measure by dividing the 50,000 by the appropriate divisor. The following are examples to convert to feet and meters.

Feet: 50,000 inches **divided** by 12 inches (1 Ft) = 4,166.7 Ft.

Meters: 50,000 inches **divided** by 39.37 inches (1 Meter) = 1270 Meters

A bar scale is a graphic representation of ground distance drawn to the scale of the map. These scales appear on most military maps in the bottom center margin. Look at your Tenino map, you will see that your map has a bar scale. The unit of measure for an individual scale appears to the right or above the scale, Figure 29.

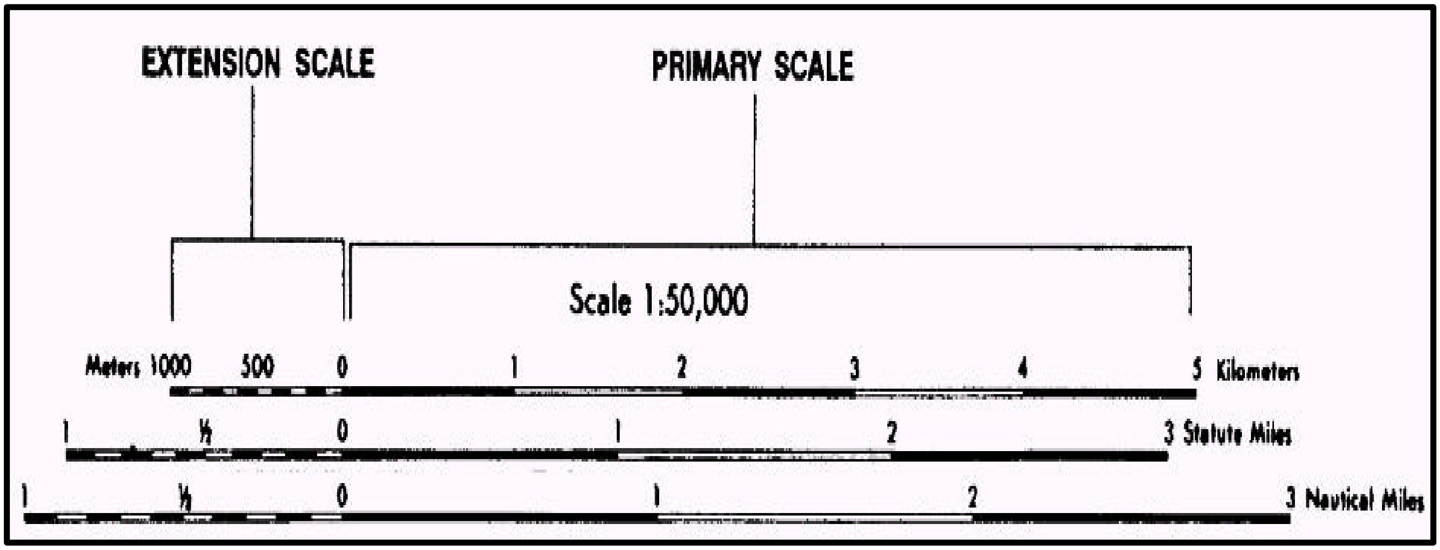
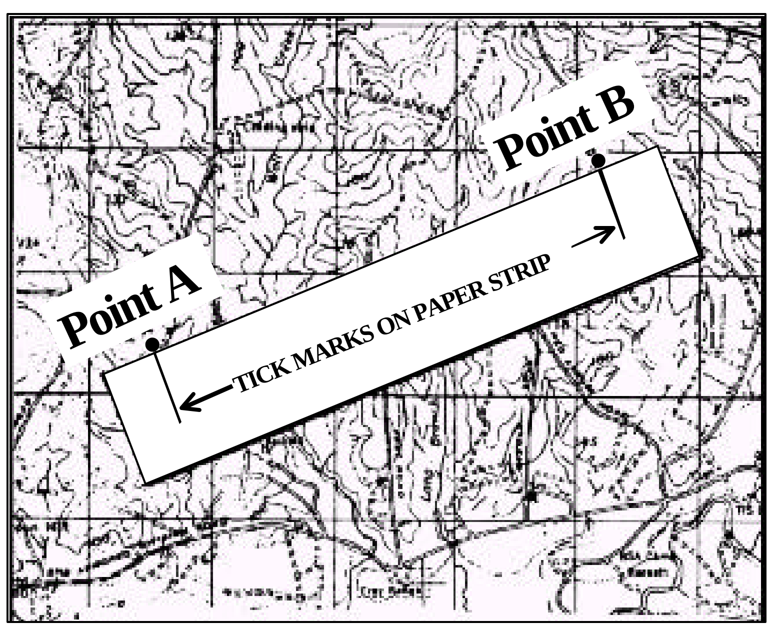


Figure 29

The bar scale shows the "primary scale" in full units of measure to the right of zero (0), and the "extension scale" left of zero shows the unit divided into tenths.

The number and types of measurement found on bar scales will vary. The most commonly used units of measurement are meters, yards, statute miles, and nautical miles. As you can see on you Tenino map, the bar scale provides all four of these measurements.

Types of Distance Measuring	The two types of distances you can measure on a map are straight-line distance and curved or road distance. In order to measure them on a map you will need: 1. A straight edge piece of paper long enough to cover your selected points on the map. 2. A sharp pencil used for marking tick marks between map points.
Straight-line Distance, continued	**NOTE:** You will now review the method to determine straight-line distance between two points. As you follow the steps below, you will use the figure given below and also perform the task on your Tenino Map. **Straight-line.** A straight-line distance is the shortest route between two points. To convert a straight-line map distance to miles, meters, or yards, perform the following: Step 1. Determine the two points between which you want to find the straight-line distance. Step 2. Align a straight edge piece of paper on the map so that the edge of the paper touches both points on the map. Step 3. Place a tickmark on the paper for both points, Figure 30.



Note: When measuring distance, use center of mass of symbol or object

Figure 30

Straight-line Distance, continued

NOTE: At this time go to your Tenino map and find Grid EG080874. At this point you should find BM 83, Point A. Next, find the TV Relay Tower at Grid EG126877, this is Point B. Once done, conduct steps two and three.

Step 4. Align the piece of paper on the bar scale for the ground unit of measure that you need, and read the distance from the graphic scale to the nearest tenth of a unit, Figure 31.

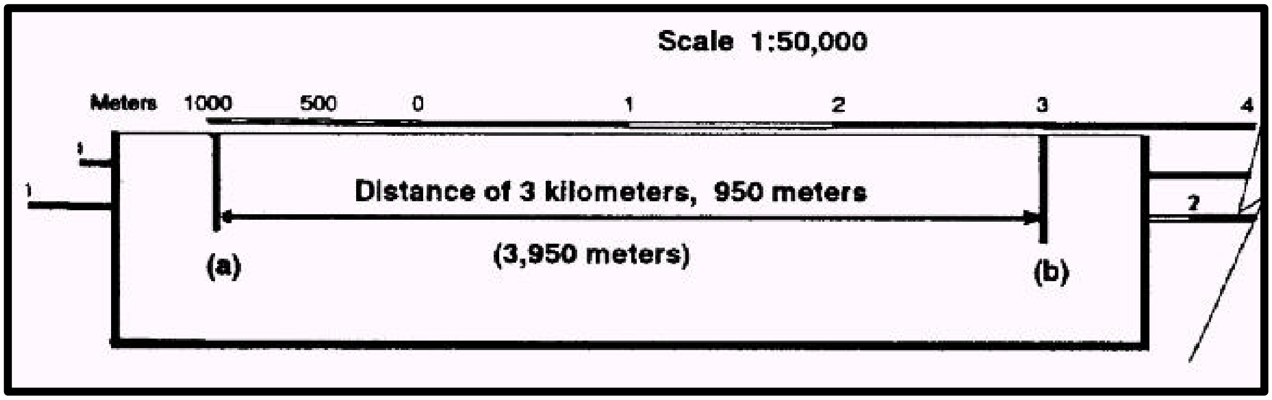


Figure 31

Step 5. Since the military measures distance in meters, lay your straight edge piece of paper on the meter bar on you Tenino map. You line up the tickmarks so that the right end is on a full 1000 meter increment in the primary scale and the other tickmark is on the inside of the extension scale. The only time your left tick mark does not fall in the extension scale is when you have a distance that is a full 1000-meter increment. In that case the left tickmarks will fall on Zero (0). By following this step of instruction, your right tickmark should line up on the 4000 meter mark, and your left tick mark should line up on 600.

Step 6. You obtain the total distance by adding the 600 meters from the extension scale to the 4000 meters from the primary scale. Therefore, you have a total straight-line distance of 4600 meters from BM 86 to the TV relay tower.

Now you will find another straight-line distance; however this time, you will have to break down the extension scale into tenths to interpolate (estimate) the distance between the 100-meter marks on the extension scale, Fig 31.

Go to you Tenino map and find the distance in meters between the water towers in grid squares EG0982 and EG1185.

NOTE: Make sure your pencil is sharp, you need to be as precise as possible

Straight-line Distance, continued

If you followed the steps above, the distance between the two water towers is 3,450 meters. In this instance the right tickmark lined up on 3000 meters on the primary scale, and the left tickmark fell halfway between the 400- and 500-meter marks on the extension scale. You must interpolate, and you should have estimated at a distance of 50 meters, the distance between the 400- and 500-meter marks on the extension scale. Therefore, you add the 450 meters to your 3000 meters from the primary scale. This gives you a total straight-line distance of 3,450 meters.

Now you will work a straight-line distance, when the distance measured (a) to (b) is longer than the bar scale. This is simple to do following the steps above with one additional step. Simply place the right tickmark on the largest number in the primary scale, and place a tickmark under the highest number of the extension scale (c) so you will know how much distance you have already measured, Figure 32A.

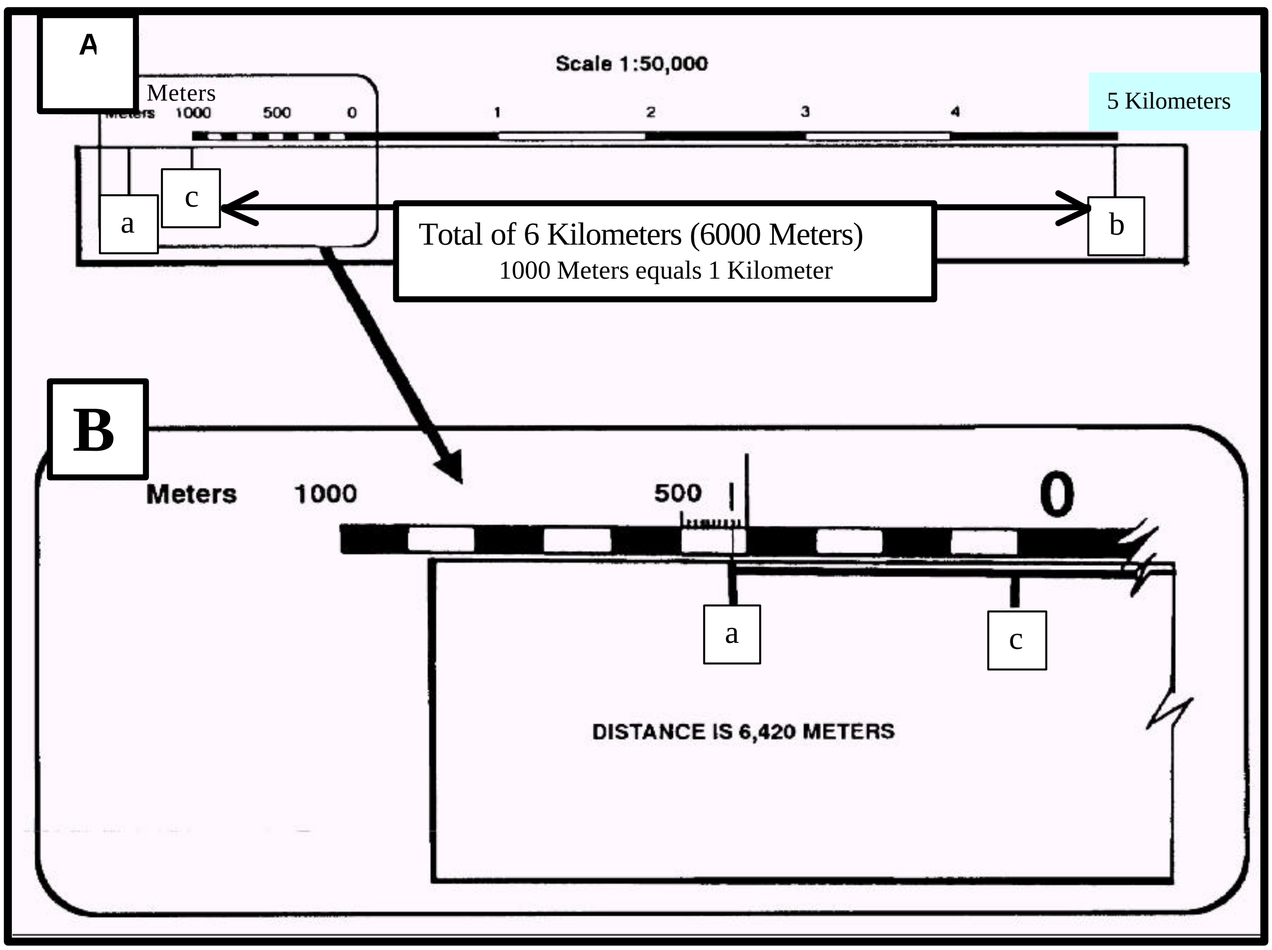


Figure 32

Straight-line Distance, continued

Take out your Tenino map and mark your straight-line measurement between the horizontal control point "Skook" in grid square EG1682 and the water tower in grid square EG1088. Mark your points A and B, then place your measurement on the meter bar scale, and mark your point C on your piece of paper, see A Figure 32.

Once you mark the distance point C between points A and B, slide the paper where as new point C is lined up in the primary scale on one of the 1000 meter tickmarks and point A lining up somewhere in the extension scale. In Figure 32, part B, the distance happens to be less than 1000 meters, so (c) lines up under the Zero (0) of the extension scale.

On your Tenino map, you see that your point C will line up under the 2000 meter mark in the primary scale and point A falls in the extension scale between the 600 meter mark and the 700 meter mark.

Now you must add everything up, as follows:

Distance between Points B and C:	6,000 meters.
Distance between Point C and Zero?	2,000 meters.
Distance between Zero and Point B	640 meters*
Total	8,640 meters

***Note:** Don't forget, when a tickmark falls between two 100-meter marks, you must interpolate (estimate) the distance. The estimated distance between the 600 meter mark and the 700 meter mark appears to be 40 meters. With a 5 percent margin of error, your distance should read between 8208 and 9072 meters.

Curved or Road Distance

The bar scales are simple to use, and there is a need for very precise work; however, many map users may find or arrive at different results. Did you come up with 8640 meters as we did with the above straight-line distance? Hopefully you were no more than 5 percent off. Just the sharpness of your pencil can make a difference. As you will see, when measuring curved or road distances, the variation of measurements will increase.

To measure curved or road distances, you will also use a straight edge piece of paper to measure the distance along a winding road, stream, or any other route following an irregular course. For the rest of this lesson, we will use roads, but remember you use the same process for any route that is irregular.

Curved or Road Distance, continued

NOTE: Before starting, make sure you pencil is sharp and you have a clean piece of paper with a straight edge. You will use the figures provided below and you will also measure a road on your Tenino map.

NOTE: It does not matter if you measure from point A to point B or vice versa. It also does not matter if you place your paper above, below, left, or right of the road **as long as you measure along the same side all the time and do not cross the road.**

Step 1. Mark on your map starting point A and finishing point B. See Figure 33.

Step 2. Place a tick mark near one end of a straight edge piece of paper.

Step 3. Align the straight edge of the paper with the road on the map so that the tick mark is on one of the points (start point in the example) and the edge of the paper extends along the route to a point where the route changes direction. See Figure 33

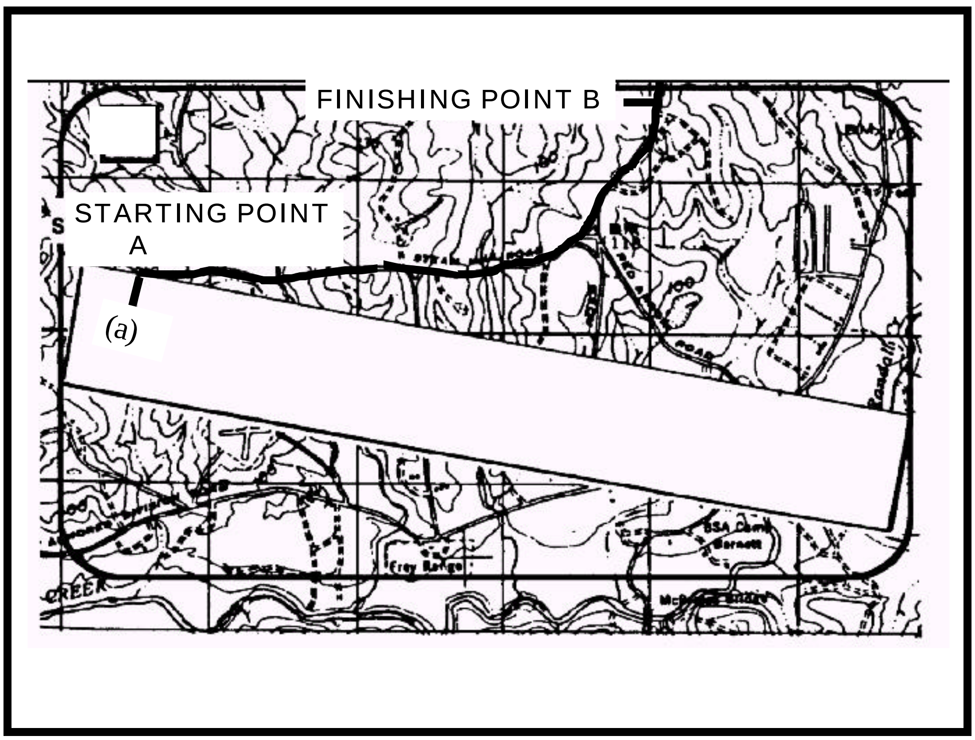


Figure 33

Curved or Road Distance, continued

Step 4. At the point where the road changes direction and does not follow the edge of the paper, place a tick mark at that point on your map and the piece of paper, Figure 34.

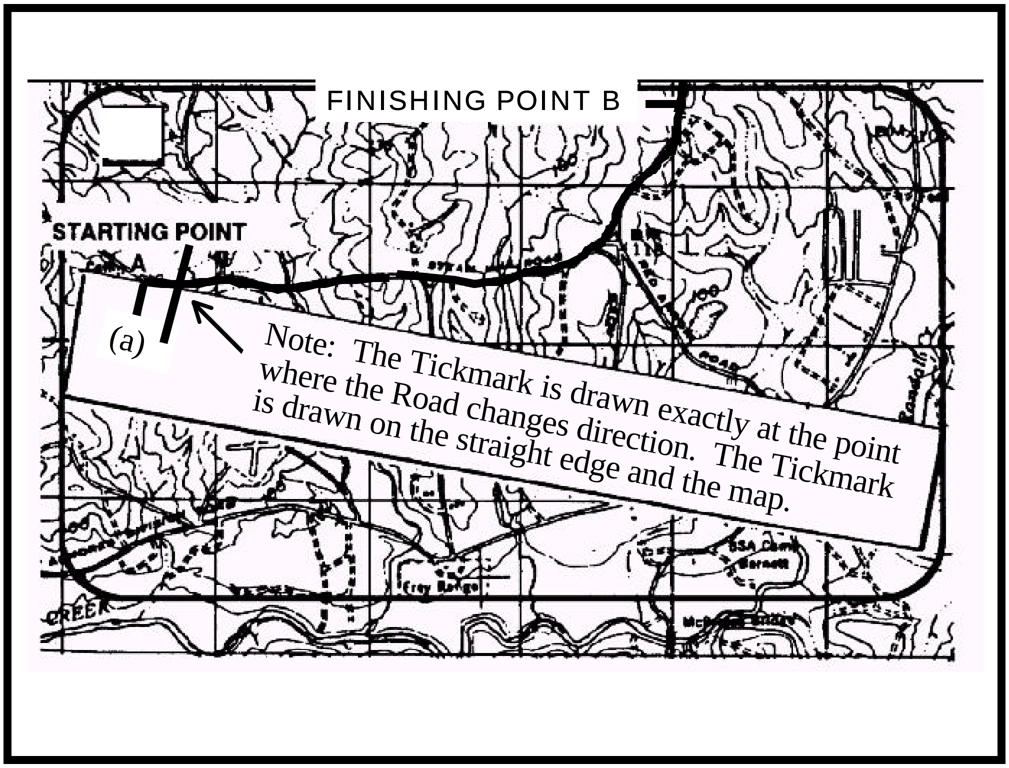


Figure 34

NOTE: Now it is time to take out your Tenino map and accomplish the first four steps above. On your map select the horizontal control station "Skook" in grid square EG16108255 as Point A and the bridge in grid square EG13558355 as point B.

NOTE: Don't forget to measure from the center of mass of the object or symbol.

Step 5. Rotate the paper so that the tickmark you just made on the paper and map are aligned and the straight edge follows the road until the road changes direction again. As before, place a tickmark on the piece of paper and the map at the location where the road changes direction. Continue this process until you reach Point B, Figure 35.

Curved or Road Distance, continued

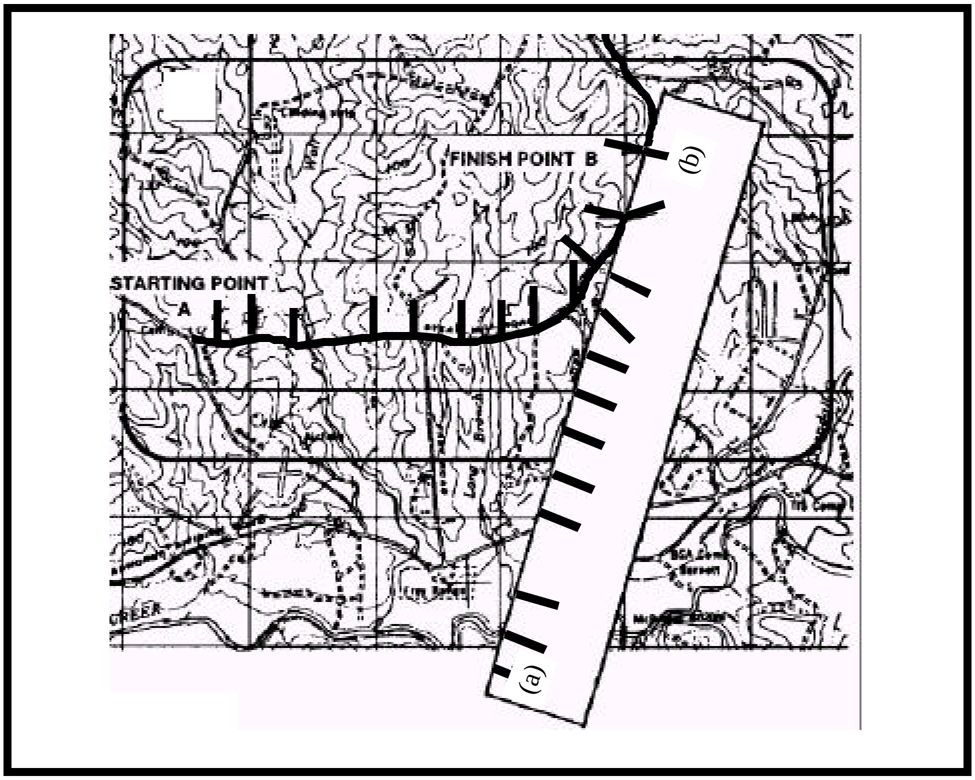


Figure 35

NOTE: Continue with step 5 on your Tenino map until you reach Point B. Once you reach Point B, you have successfully taken the curved road or route and turned it into a straight-line measurement on your piece of paper.

Step 6. Now that you have a straight-line measurement, determine the distance on the bar scale the same way to you learned to measure straight-line distances.

NOTE: After determining the distance on your meter bar scale on the Tenino map, your distance should be 3240 meters. With a 10 percent error margin, your distance should read between 2916 meters and 3564 meters.

Now let's take time out to check your proficiency in determining distances on a map by measuring straight-line distances and curved or road distances. Take Quiz Three on the next page.

Determine Direction Without a Compass

Task This section of the RTP teaches--

Task Number:	071-329-1018
Task Title:	Determine direction without a compass.
Conditions:	During daylight and at night (with a clear view of the Big Dipper), given a wristwatch (not digital), you must determine direction in a field environment with natural vegetation available.
Standards:	Identify north and east within 15 degrees.

(References: FM 3-25.26, Chapter 9; STP 21-1-SMCT, Oct 94, page 60)

Shadow-Tip Method

The shadow-tip method is a simple and accurate method of finding direction by the sun. You can use it to find the four cardinal directions (north, south, east, and west).

Step 1. Place a stick or branch A into the ground at a level spot where the sun will cast a distinctive shadow, see A, Figure 35. Place an object (stone, twig, etc) at the tip of the shadow, see B, Figure 35. This first shadow mark is always the west direction.

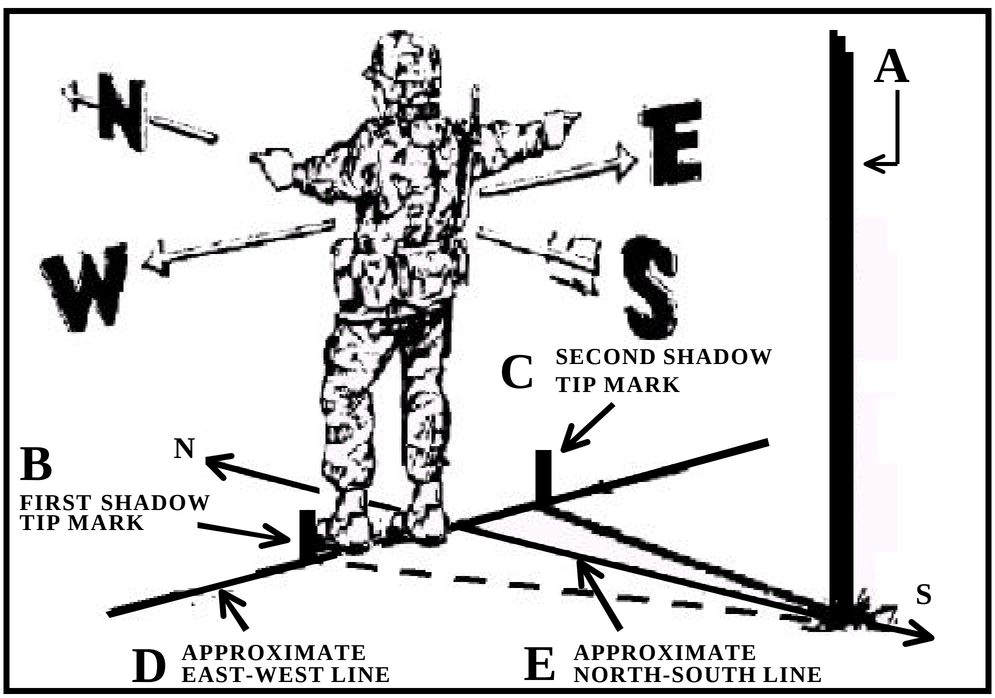


Figure 35

Shadow-Tip Method, continued

Step 2. Wait 10 to 15 minutes until the shadow tip moves. Mark the new tip of the shadow in the same way as you did the first shadow tip, see C, Figure 35. This will be your eastern setting.

NOTE. Since the sun rises in the east and sets in the west, the first shadow tip you mark is always west and the second mark is always east.

Step 3. Draw a line through the two marks/points that you made of the shadow tips to get an approximate east-west line, see D, Figure 35.

Step 4. Standing with the first mark (west) to your left, the other directions become simple. You are facing north, to your right is east and to your rear is south, Figure 35.

NOTE. A line drawn perpendicular to the east-west line at any point is the approximate north-south line, see E, Figure 35.

Watch Method

You can use a watch to also determine the approximate true north and true south. You must use a watch that has hands.

1. North Temperate Zone. For standard time, point the hour hand toward the sun. You can find a south line between the hour hand and 1200 hours, Figure 36. For daylight saving time, you will find the north-south line between the hour hand and 1300 Hours.

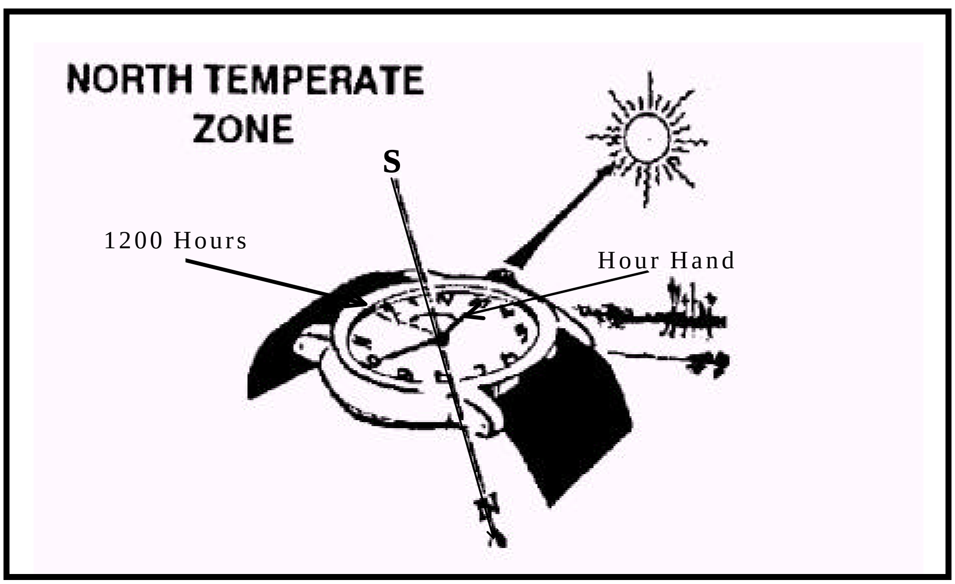


Figure 36

Watch Method, continued	**NOTE**: If there is any doubt as to which end of the line is north, remember that the sun is in the east before noon and west after noon. 2. Southern Temperate Zone. Refer to Chapter 9, FM 3-25.26, page 9-8 for instructions on this method.
Star Method at Night, Northern Hemisphere	The main constellations to learn are the Ursa Major--Big Dipper--and Cassiopeia. Neither of these constellations ever set. They are always visible on a clear night. Use them to locate the North Star, also known as Polaris or Polar Star. The North Star forms part of the Little Dipper--Ursa Minor--handle and could cause confusion with the Big Dipper. Prevent confusion by using both the Big Dipper and Cassiopeia together. The Big Dipper and Cassiopeia are always directly opposite of each other with the North Star between them, Figure 37. They rotate in a counterclockwise direction around the North Star. So, the North Star stays stationary in the sky.
Star Method at Night, Northern Hemisphere	The Big Dipper is a seven-star constellation in the shape of a dipper. The two stars forming the outer lip of the dipper are "pointer stars" because they direct you to the North Star. Mentally draw a line using the two "pointer stars." Starting with the "pointer star" at the closed end of the Bid Dipper, draw a line through the second "pointer star" to a distance of about five times the distance between the pointer stars. At this point you will find the North Star.

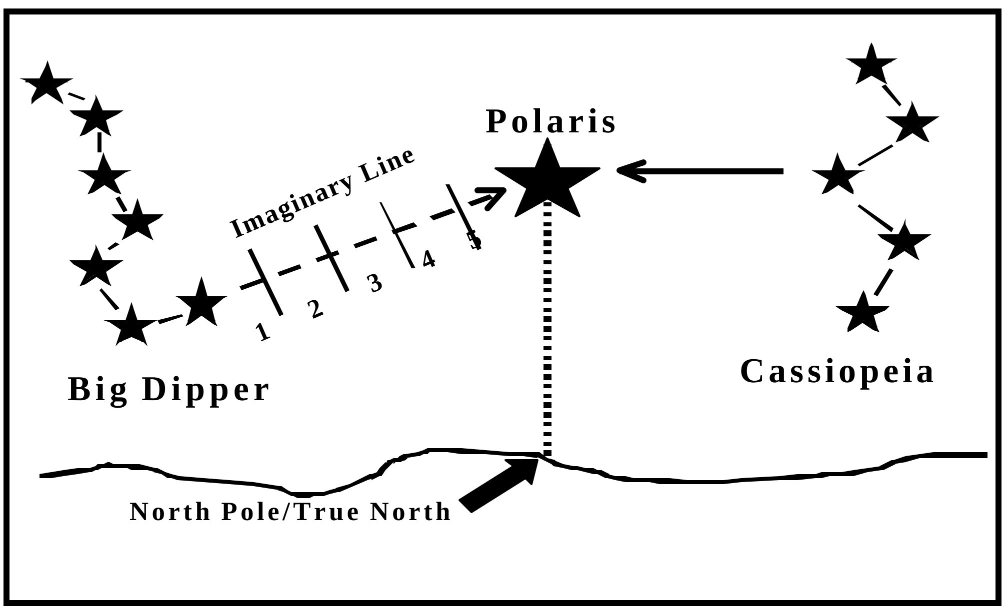


Figure 37

Cassiopeia has five stars that form a shape like a "W" or "M" on its side. The North star is straight out from Cassiopeia's center star, Figure 37.

Once you find the North Star, you locate the North Pole or True North by drawing an imaginary line directly to the earth from the North Star.

NOTE. The North Star is less than one degree off true north and does not move from its place in the sky because the axis of the earth is pointed towards it. This is why the Big Dipper and Cassiopeia rotate around the North Star.

Star Method at Night, Southern Hemisphere

Refer to Chapter 9, FM 3-25.26, page 9-10, for information on the star method at night, southern hemisphere.

Orient a Map to the Ground by Map Terrain Association

Task

This section of the RTP teaches--

Task Number:	071-329-1012
Task Title:	Orient a map to the ground by map terrain association.
Conditions:	Given a standard 1:50,000-scale military map in the field in daylight.
Standards:	Orient the map to within 30 degrees of north.

(References: FM 3-25.26, Chapter 11; STP 21-1-SMCT, Oct 94, page 58)

Terrain Association

You can orient your map by terrain association when you don't have a compass, or you want to make a quick reference as you move across country.

Using this method requires a careful examination of the map and the ground. You must know your approximate location and a knowledge of the terrain features appearing on your map so you can compare them with the physical features on the ground.

Hold the map in a horizontal position and line up the features you see on the ground with those on the map. If you have a compass, you can check your orientation by:

1. Placing a compass along one of the north-south grid lines to keep from orienting the map in the wrong direction, meaning 180 degrees out.
2. Aligning two or more features, e.g., a swamp to the left, and a water tower near a known city.

Determine a Location on the Ground by Terrain Association

Task

This section of the RTP teaches--

Task Number:	071-329-1005
Task Title:	Determine a location on the ground by terrain association.
Conditions:	In the field during daylight, while at an unknown location on the ground, given a standard 1:50,000-scale map of the area, pencil, paper, a coordinate scale and protractor, and a known point on the ground.
Standards:	Determine the six-digit coordinate of your location with a 100-meter tolerance within seven minutes.

(References: FM 3-25.26, Chapter 11; STP 21-1-SMCT, Oct 94, page 51)

Determine Location by Terrain Association

First you must determine the terrain features of your location. You must have a knowledge of the terrain features appearing on your map so you can compare them with the physical features on the ground at your location.

Orient the map to the ground by terrain association, and then determine the four cardinal directions (north, south, east, and west). Remember, you can determine the directions by lining up know terrain features on the ground with those on your map, e.g., swamp on the left, and a known town on the right. Also, you can use the shadow-tip method of direction.

To determine your location, you must relate the terrain features on the ground to those shown on the map. After determining where the terrain features on the ground and those on your map coincide, determine the six-digit grid coordinate of your location using the coordinate scale and protractor.

This concludes the RTP